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The Stars

Not everyone has seen the stars. Certainly those, who by misfortune have never possessed the sense of sight, have not seen the stars. And there are some, who, unhappily, are forced to pass the years of their existence so hemmed in by the limitations which a large city necessarily sets that they too are as unaware, so far as their experience is concerned, of the splendor of the stars as they are of the beauty of the green grass and of the leafy trees. But there are others who are blessed with normal eyes and who have the fredom to go and come as they please of whom it still may be said, in a figurative sense, that they have not seen the stars.

It is true that no one with seeing eyes who is out of doors in the open country on a cloudless night can fail to receive the effect of the thousands of beams of light which pass through the pupil of his eye and impinge upon the retina. He *sees* of necessity the seemingly countless points of light of different brightnesses and of various colors. But if this is all, he *sees* the stars with his eyes only and not with his mind.

Only he has mental vision of the stars who sees in them storehouses of almost inexhaustible supplies of energy; quantities of matter sufficient for millions of earths; denizens of space whose boundaries, if any, are so remote as to baffle comprehension; units in a vast system which itself may be a unit in a vaster system of systems; objects which infinitely surpass man in every respect except in the one respect of thought; and, withal, subjects to an all pervading, all comprehensive law which holds each unerringly in its course, thereby bringing harmony out of confusion, rhythm out of disorder, cosmos out of chaos.

He who sees these things and, with his capacity for thought, penetrates what is seen and grasps what is implied, by so doing raises himself from a mere atom on an obscure planet and links himself with the unbounded spirit of thought whose dwelling is among the stars.

Happy is he who has thus seen the stars.

THE MASS AND DENSITY OF PLUTO

Are the claims that it was predicted by Lowell justified?

By WILLIAM H. PICKERING.

SUMMARY OF THE HARVARD RESULTS.

1. The Harvard determination of the location of Pluto was based on its perturbation, that is to say its slight displacement, of the planet Neptune.

2. The planet Uranus to be sure was also used, but only in a very minor way, and the orbit deduced from it, which was unsatisfactory chiefly in point of size, gave the position of Pluto when it was discovered in 1930, curiously enough, practically in coincidence with that deduced by Lowell, with an error of over 5°.[1]

3. The present perturbation of Neptune was foreseen and published in 1908, before it had actually begun.[2]

4. It proved to be a real perturbation, amounting to four seconds of arc,[3] as determined from measures made at Greenwich and Washington, not an insignificant one too small to be detected, such as we now know was the case with the supposed perturbation of Uranus, which amounted to only about half a second.[4]

5. By means of the perturbation of Neptune, and an empirical formula devised for the purpose,[5] the position of Pluto was computed for the year 1920, and the result published in the *Harvard Annals* in 1919.[6] Photographs for the purpose of detecting it were taken at the Mt. Wilson Observatory, but it was not found upon them. These photographs were re-examined last July, and the planet was then found in a position differing from the computed place in right ascension by but 1°15.[7]

6. Its correct magnitude or brightness 15, was also given in the *Annals*.[6]

7. The rational method of locating an unknown planet, devised by Adams and Leverrier, was not applicable to the case of Pluto because Neptune had only been observed through one-half of its orbit.

8. In 1928 it was seen that the earlier orbit was too large, and the computed mass was reduced from 2 to 0.75.[3]

9. This reduction in size of the orbit also involved its intersection with that of Neptune under favorable circumstances, something like the two links of a chain, a fact hitherto without precedent among planetary orbits. This result was also published at the time.[3]

10. Besides this novelty, seven other features of the orbit and planet were predicted, either in the *Harvard Annals* or in POPULAR ASTRONOMY with reasonable success.

	Predicted	True
Location[6 7]	$6^h\,34^m$	$6^h\,29^m$
Date of Perihelion[6 8]	1720	1740
Eccentricity[6 8]	0.31	0.25
Longitude of the Node[6 8]	100°	109°
Inclination[6 8]	15°	17°
Magnitude[6 9]	15	15
Mass[10 2]	0.71	0.75(?)

11. The mass has not yet been accurately determined, but if the above value is nearly correct, the density is evidently considerable, and may even be greater than that of platinum, suggesting in that case that Pluto may turn out to be a piece of a star approaching the white dwarf type.[10]

12. These facts could not be presented earlier, because they depend on the true orbit of the planet, which was unknown prior to August, 1930.

[1] POPULAR ASTRONOMY, 1930, **38**, 287.
[2] *Harvard Annals*, 1908, **61**, 155.
[3] POPULAR ASTRONOMY, 1928, **36**, 220.
[4] POPULAR ASTRONOMY, 1931, **39**, 3.
[5] POPULAR ASTRONOMY, 1928, **36**, 159.
[6] *Harvard Annals*, 1919, **82**, 59.
[7] *Lick Observatory Bulletin*, 1930, **427**, 35.
[8] *Lick Observatory Bulletin*, 1930, **427**, 40.
[9] POPULAR ASTRONOMY, 1930, **38**, 189.
[10] POPULAR ASTRONOMY, 1931, **39**, 7.

DETAILED STATEMENT.

The mass of this planet has been estimated by various computers hitherto from various points of view, the data employed by them being generally based either on the perturbation of Uranus and an erroneous orbit, or else simply on visual or photographic estimates of magnitude, combined with a guess at the albedo and density. The masses accordingly have ranged all the way from Lowell's at 7.5, in terms of that of the Earth, down to 0.1 based on the assumed density. In the *Lick Observatory Bulletin* of August 6, 1930, Number **427**, we at last have an accurate orbit computed by Messrs. Bower and Whipple, based on four photographs taken in December, 1919, one in January, 1921, two in January, 1927, and numerous ones in 1930, beginning with one taken in January, and ending with one taken early in April. From this orbit they deduce that Uranus was in conjunction with the planet in 1853 at a distance of 30 units, and that Neptune was in conjunction with it in 1892 at a distance of 18 units.

In POPULAR ASTRONOMY for 1928, **36**, 163 and 220, we show that the maximum perturbation of Uranus in 1926, due to its much earlier conjunction with Neptune at a distance of 10.2 units, was 88″, and that the maximum perturbation of Neptune, believed to be due to its conjunction with Pluto, at a distance of 18 units as we now know it, was 3″.9. This perturbation was foreseen and published in 1908, *H.A.*, **61**, 155, but a sufficient number of observations to secure a preliminary determination of the date of the maximum could not be secured before 1919, as we shall presently see. The reasons for our belief that this perturbation of Neptune was due to its conjunction with Pluto in 1892 are as follows. The marked perturbation curve, POPULAR ASTRONOMY, 151, is of precisely the same shape as that shown by Uranus when it was perturbed by Neptune, p. 147, shortly after their conjunction, and the perturbation occurred as we shall presently show at just the proper place in Neptune's orbit. Some perturbation of Neptune must certainly have occurred when it passed Pluto, and it is now certain from the observations made at Greenwich and Washington that this perturbation did not exceed 3″.9.

In order to determine the corresponding perturbation of Uranus by Pluto, which must have occurred some years after 1853, we shall make use of the additional facts that the masses of Uranus and Neptune in terms of that of the Earth are 14.7 and 17.2. Were it a case simply of relative distance and mass, the maximum perturbation of Uranus by Pluto would be simply $3''.9 \times 18^2 \times 17.2/(30^2 \times 14.7)$, or 1″.64, but we must also consider the fact that Uranus is moving faster in its orbit than Neptune, and so does not stay long enough in any given position to be pulled very far. In fact it passed Pluto at a rate of 3°.39 a year, while Neptune passed it at a rate of only 1°.16. Reducing these arcs to linear measure and squaring, we obtain the ratio 3.36. Dividing 1″.64 by this figure gives the maximum perturbation of Uranus as 0″.5. The

accurate computation is much more complex than this, but this figure cannot be far out of the way.

The perturbation of Neptune alone, while it cannot give an orbit, can and does give a position for the unknown body, and this is far more important, since the orbit can be readily obtained, once the object is discovered. Indeed no computer who has hitherto tried it has been able to predict an orbit for an unknown planet, whether Neptune or Pluto, that bore any particular resemblance to its real one. In 1919 the writer thought that a maximum perturbation of Neptune had occurred in 1910. From the longitude of Neptune in that year, the longitude of planet *O*, as it was then called, was computed by means of the empirical formula described and explained in POPULAR ASTRONOMY, **36**, 159. This proved to be 92°.8. A correction was then made by means of my computed orbit, to bring the planet up to the date 1920.0, that of my epoch. This correction was only 5°, so although the orbit was worthless, as we now know, the correction cannot have been very far out of the way. This correction made the longitude of Pluto, as it is now called, 97°.8. This when reduced to right ascension gives the position $6^h\,34^m$, which is the figure published in the *Harvard Annals*, **82**, 59, over the date November, 1919. In the following December four plates were taken of this region at Mt. Wilson by Dr. Humason, but the planet was not found upon them. A re-examination made last July, however, showed four very faint images of Pluto. Since at this time Pluto was in declination +19°, the error of 5^m is reduced to 1°.15, a result fairly comparable in accuracy to those of Leverrier and Adams, whose errors were 0°.87 and 2°.45 respectively. My estimated magnitude 15 proved to be correct. It was impossible to give these facts earlier, until Pluto had been found on the plates taken in 1919, and until an accurate orbit of that body had been published by Messrs. Bower and Whipple. They have now been presented at the earliest opportunity.

The writer's empirical formula has now, therefore, given satisfactory results in the two very dissimilar cases of the perturbation of Uranus by Neptune, and of Neptune by Pluto, the latter being an actual case of prediction, where it has not been found wanting. It is thought, therefore, that it may be successfully applied to any plausible future case that may arise. The rational method of computing adopted by Leverrier and Adams on the other hand would have been wholly inapplicable to the discovery of Pluto by means of the perturbation of Neptune, because the orbit of that body is not complete, nor will it be until the year 2011, when doubtless Pluto would have been found, had it not been already accomplished by the astronomers of the present generation. It is to be regretted in a way when Dr. Humason took the four plates in 1919, on which Pluto has since been found, and the magnitude was as stated, that longer exposures could not have been given, or that the planet was not recognized at that time in spite of its faintness, since it would have given us ten additional years of possible perturbation, as well as adding to the luster of the two observatories concerned.

In connection with the otherwise peculiar orbit of this body, it may be well to call especial attention to the fact that it and the orbit of Neptune actually intersect, a fact unknown among the other planets. The mean distance of Neptune from the Sun is 30.07, while the perihelion distance of Pluto is only 29.55, so that Pluto is then nearer to the Sun than Neptune, and hence at some distant date, owing to the revolution of the nodes and apsides, they might even collide, or have lain very near to one another in the past. In POPULAR ASTRONOMY, 1928, **36**, 161 and 220, comment is made on this peculiarity, now proved, and the statement is made "It indicates, however, very clearly that the orbit of *O* (now called Pluto) sometimes does lie within that of Neptune." This intimate and exceptional relation of the two planets naturally suggested that planet *O* should be called either Salacia after the wife of Neptune, or Amphitrite after the wife of Poseidon, the Greek equivalent of Neptune. This would have saved the name Pluto, a name first suggested in print in POPULAR ASTRONOMY, 1930, **38**, 292, to be given to the large, but still unknown planet revolving outside of Neptune at a distance of about 70 units, as determined by both planetary perturbations and cometary aphelia. (POPULAR ASTRONOMY, **36**, 417.)

It may be mentioned in this place as an interesting coincidence that at the end of the report in the *Harvard Annals*, the longitude of the ascending node of Pluto's orbit is given as $100° \pm 5°$. Its true value is 109°. The inclination is given as $15° \pm 5°$. Its true value is 17°. These were not mere guesses, however. They were based on the later deviations of Uranus and Neptune to the south, and taking everything into consideration, they were estimated at what these deviations as it seemed to me would require.

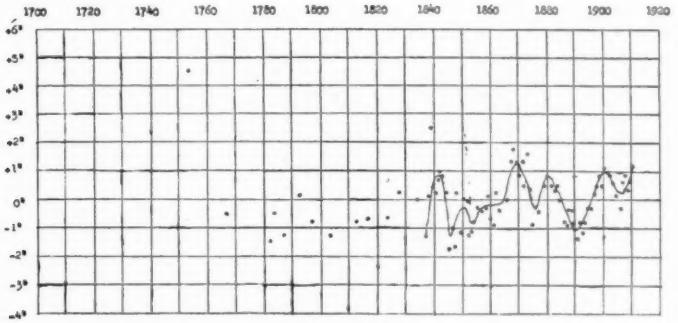

FIGURE 1.
GAILLAUD'S RESIDUALS ACCORDING TO LOWELL.

I am very sorry to have to digress at this point to say a few words regarding Dr. Lowell's work on this planet. I certainly should not have referred to it at all but for the surprising and reckless claims to the exclusive prediction of its location, put forth by his active adherents and

administrators, backed up by very extensive newspaper propaganda. Figure 1 is taken directly from Plate II of his Memoir on planet X, now called Pluto. The abscissas give the years, the ordinates the deviations in longitude according to him, combined with the accidental errors of observation of the planet Uranus from the orbit which it should have followed had planet X not existed. The true perturbation due to Pluto should have produced a long smooth curve of the shape shown in my previous references, with maxima of 0".5 in extent, as we have just seen, separated by an interval of about a hundred years. Minima following the maxima should be of about the same size, and minute secondary maxima of less than 0".1 should have occurred halfway between the chief ones. A glance at Figure 1 will show that its irregularities are due wholly to accidental errors of observation. It therefore would be utterly impossible to compute either a position, or an orbit for Pluto based on the observed perturbations of Uranus alone, as Dr. Lowell attempted to do. Even as an aid to the perturbation of Neptune, which planet the writer employed, they would be perfectly useless.

No astronomer that I can recall has pointed with pride to Lowell's success in locating the planet at a longitude differing by a little over 5° from its actual place in the sky. It was over 6° at the time for which he actually computed it in 1914.5. No one who has carefully studied his work has expressed confidence that even this very moderate success was due to other than mere accident. None has stated that the very excellent and extensive mathematical work that Lowell published had any particular relation to the irregular deviations in the orbit of Uranus now actually observed. Without further comment on my part, I may perhaps be permitted to call the attention of his active adherents to the views expressed by some of America's prominent astronomers as to the propriety of these claims. I shall refer first to Professor E. W. Brown of Yale University, a leading world authority on Planetary Perturbations. He presented a paper on this very subject to the National Academy of Sciences at its Washington meeting in May, 1930. This paper will be found in their *Proceedings*, **16**, 364. It is a very interesting and instructive paper, but I shall confine myself here to reproducing merely a portion of three paragraphs of it. Professor Brown says:

"It then appears that the actual values which he [Lowell] obtains for the distance, mass and eccentricity substantially depend on three groups of observations made before 1783, having large probable errors. [See Figure 1.] Further, the residuals exhibited by Uranus during the twenty years which have elapsed since the last observation utilized by him in the work seem to bear no resemblance to those which either of his solutions requires. Indeed it is doubtful if a solution which will substantially account for the new residuals is possible.

"It is unfortunate that, if my analysis is correct, so much careful and laborious work can lead to no result. * * *

"The information concerning the newly found planet available at this moment is scanty but it appears to be sufficient to prove that it could

not have been predicted from its effect on Uranus. On the most favorable assumption as to albedo (0.06) and density (5.6), the mass cannot be much greater than that of the Earth or one-seventh of that predicted by Lowell. At the distance of 40 to 43 units the perturbations of such a planet on Uranus are not within the range of detection from the material available. Among the numerous solutions given by him, only those with an eccentricity of at least 0.5 appear to be possible and these will leave the unweighted sum of the squares of the residuals greater than 22. Such a solution, however, puts the planet more than 30° away from the place where it was found. This last statement refers to the perturbations as actually computed; as a matter of fact, the calculations are quite inadequate with such a high eccentricity. We must therefore regard the fact that it was found near the predicted place as purely accidental."

Messrs. Bower and Whipple, who have probably spent more time in discussing the real orbit of Pluto than anyone else, have expressed analogous and even stronger views on the subject, in the *Pub. Astr. Soc. Pacific*, 1930, **42**, 239, since they even doubt if the effect on the orbit of Neptune would have produced an appreciable perturbation! I think, however, if they look the matter up they will be convinced that some effect is noticeable in that case.

Having digressed somewhat from our original topic, in order to state the views of some other astronomers whose opinions should carry weight, we will now return to our original subject matter, the mass of Pluto. Let the mass of Uranus divided by the mass of Pluto equal $88'' \times 10.2^2 \times 14.7/(3''.9 \times 18^2 \times 17.2) = 6.56$. Then the uncorrected mass of Pluto is 2.24 in terms of that of the Earth. Correcting this figure for the relative speeds of the planets as before, the mass of Pluto is reduced to 0.71. In Popular Astronomy, 1928, 220, it is given as 0.75 in place of the earlier value 2. Information regarding the diameter of Pluto is naturally rather scarce, but at Meudon I find that M. Baldet with the 32-inch refractor states that at most it cannot exceed 4000 miles. (*Journ. Brit. Astron. Assoc.*, 1930, **40**, 248.) Taking the density of the Earth as 5.5, we find that the density of Pluto is $0.71 \times 8^3 \times 5.5/4^3 = 31$, or about one and a half times that of platinum. In case the diameter is less than 4000 miles, as may well be the fact, then the density will be greatly increased. Thus with a diameter of 3000 miles the density would reach 73. If this conclusion is correct then Pluto is the first planetary body discovered whose internal structure indicates that it had an origin outside of the solar system. Its density would thus seem to imply a relationship to those stars described as being of the white dwarf type.

Private Observatory, Mandeville, Jamaica, B. W. I., October 6, 1930.

JOHANN GEORG HAGEN S. J.

By J. STEIN.

[This paper was translated from the German by Matthias F. Schmitz, a member of the Department of German in Carleton College.—Ed.]

On the fifth of September, 1930, Father Johann Georg Hagen died in the twenty-fifth year of his directorship of the Vatican Observatory. He was born on the sixth of March, 1847, at Bregenz on the Lake of Constance, and had reached, therefore, the age of 83 years and 6 months. His father, Martin Hagen, was a teacher at Lochau nearby from 1815 to 1825 where the family had lived since 1650. In 1825 he moved his residence to Bregenz and filled an appointment as teacher up to 1856 when he retired. His marriage to Theresia Schick in 1841 was blessed with three sons and three daughters of whom two died quite young. Johann, the next to the youngest, lived longer than any of them. After attending the elementary school at Bregenz from 1853 to 1858 and for another year the secondary school he was sent to the college of the Jesuits in Feldkirch. The larger liberty that he enjoyed here as an externe he utilized, among other things, in mountain climbing whereby his feeble health was strengthened. In 1863, at the age of sixteen years, he entered the Society of Jesus. After the novitiate in Gorheim near Sigmaringen he came to Friedrichsburg in Münster in order to study classical philology and rhetoric, and in 1867, for the study of philosophy, to Maria Laach. The study of the exact sciences attracted him very much and, following his own suggestion, his superiors sent him, in the year 1870, to the Academy of Münster where he heard the lectures of his beloved teacher, Heis, on mathematics and astronomy. In the next year he studied mathematics and physics at the University of Bonn under Professors Lipschitz, Ketteler, Kortum, Giesen, and Clausius. In the year 1870 he had volunteered for ambulance service in France. However, after a week in this service he fell sick himself with typhoid fever and lost thereby a half year of his already curtailed academic training. In 1872 he was forced to emigrate to Austria owing to the May-Laws. In Feldkirch he taught mathematics for three years in the lower four classes of the secondary school. In the year 1875 he began his theological studies in Dittonhall near Liverpool and was ordained a minister in 1878. After finishing his theology he received an appointment, in the year 1880, at the college in Prairie du Chien, Wisconsin. Here he built up a small, primitive observatory in which he began to observe the variable stars.

His appointment as director of the Observatory of Georgetown College at Washington followed in the year 1888. Here he received everything that he possibly could desire in order to bring his intellectual gifts to complete development: a spacious observatory with a 12-inch re-

PLATE I

JOHANN GEORG HAGEN S. J.
1847-1930

fractor, a photographic transit instrument, a large library in the Naval Observatory, association with learned specialists and scientific organizations. Here came to fruition his large plan which he had already conceived in 1883 and which was to win for him greatest fame, namely, the "Atlas Stellarum Variabilium." The observations with the 12-inch for the first six series were begun the first of October, 1893, and finished on the twenty-third of November, 1905. The first three series were published before Hagen's departure from Georgetown; the fourth to the sixth series, in the years 1906-1908; the seventh with the coöperation of Professor Graff and Dr. Esch, in Rome in 1927. In the year 1916 was published a supplement of 142 small charts.

The hearty manner in which the late Professor Turner greeted the first four series of the "Atlas Stellarum Variabilium" in the year 1907 indicates so clearly the character of the work and its author and is at the same time so characteristic of the reviewer that the reader will pardon me for quoting here somewhat at length from Professor Turner's review which appeared in *The Observatory*, **30**, (1907), 348-9.

> Hagen's Variable Star Atlas represents a painstaking, laborious piece of work done by eye and hand in a field where we have lately come to regard photography as the obvious method; for the measures are differential throughout, and though photographic processes have not as yet taken their proper place in meridian astronomy, their pre-eminence for differential work would be generally admitted.
>
> Father Hagen had, however, begun his arduous labours before the modern regime; in the early nineties the photographic method was still in the experimental stages, and however good its prospects of future success may have been, the moment was not one at which to abandon a project already well advanced for an uncertain improvement. If this were all, we should be content to admire the energy which carried the work to a conclusion in face of the obvious discouragements due to threatened supersession. If this were all, Father Hagen would still be the first man to make a whole voyage which others had only commenced, and it would be all the more creditable to him that he had done it in a sailing-ship at the moment when steam was going to reduce the difficulties. But it is not all. It does not seem at all impossible that for the particular voyage he has just completed sails and not steam may be the better equipment, at any rate for a large part of the way. If we desire to get accurate relative *positions* of the stars within a limited region, the photographic method is almost certainly the best; but it is the relative *magnitudes* of the stars, and not their positions, which are important in an Atlas of Variable Stars. Now no one who has tried to get accurate magnitudes from photographs will as yet be eager to urge the claims of the photographic over visual methods, especially when it is remembered that (*a*) the magnitudes are wanted for use in *visual* work, (*b*) those of the faint stars should be as accurate as those of the bright. When these points are borne clearly in mind, it will be obvious that a large part of the work of forming the Atlas must be done at the telescope, though photographs might have helped in determining positions. The latter, however, need not be very accurate; all that is necessary being to secure identification. Thus Father Hagen may be by no means the last sailor; we may still hope to see plenty of beautiful white canvas, notwithstanding the greater speed of the black smoke.
>
> The voyage on which he embarked some fifteen years ago is at last happily and prosperously concluded, and he reverently glorifies God for his safe return to port: *"Faxit Deus, quo magis in dies caeli enarrent gloriam Suam, ut hoc Atlante via paretur ad Stellarum Variabilium arcana altius investiganda, planius intellegenda."* On rising from his knees

> he may well look for hearty congratulations from his fellow astronomers and grateful thanks from those in whose interests he has toiled for so many years. Some of these cannot thank him at the moment, because they are not yet born as variable-star observers—perhaps not yet born in the actual flesh. Others who would thank him have passed away. I well remember my first introduction to the Atlas, which was also my first meeting with the late Sir Cuthbert Peck. The occasion was some visit to the R. A. S. Library, for one of the thousand different purposes which draw one thither, and I found Sir Cuthbert Peck turning over the leaves of the newly-arrived installment of the Atlas with the careful fingers of a man who well knew its worth. And I am tempted to add that it is not only the observers of variables who are in debt to the maker of the Atlas; there are others who have had to collate old observations, who find one chart substituted for another with only internal evidence to tell of the change; who find two observers professing the same chart and giving inconsistent readings; who find the same observer using as many as sixteen different charts for the same star—men who have had such experiences know the value of Father Hagen's work, if only observers will, for the future, generally adopt it; and such men meditate, somewhat sorrowfully it may be, on the labour and uncertainty that might have been saved if Pogson had been able to carry through the similar project on which he started half a century ago.

In addition to the *Publications of the Observatory* the first three volumes of his "Synopsis of Higher Mathematics" gave evidence of Hagen's work in Georgetown. He occupied himself even at that time with the plan to edit the complete works of the famous mathematician, Euler, and presented the "Index operum Leonardi" to a conference of German mathematicians in Frankfurt on the Rhine in 1896. As is well known, the works of Euler are now published by the Swiss National Scientific Society. Father Hagen later thanked Providence that he had not succeeded in getting the necessary financial support for this enormous work as it would have required too much of his time and energy.

In the year 1906 Father Hagen at the suggestion of the Archbishop of Pisa, later Cardinal, Pietro Maffi, president of the Specola Vaticana, was called to Rome by Pope Pius X. The first and principal task was to set going the work of the Zone (55°-64°) of the Astrographic Chart which had been undertaken by Leo XIII. For this purpose Father Hagen visited in the summer of 1906 those observatories which were engaged in this work and then ordered from Repsold the necessary measuring apparatus. The calculations of the plate constants and the tables for the transformation of the coördinates was done by Professor Turner in Oxford. The consequence was that Father Lais zealously went on with the photography of the zone; the measurement of the plates was completed in 1921, and the printing of the ten volumes was finished in 1928. Then the observatory was to be transferred to the Vatican Gardens and reorganized. In addition to the tower of Leo, more than one thousand years old, where the photographic refractor was mounted, a second similar tower was arranged for a visual 16-inch, and the nearby villa of Leo XIII was remodeled for the home of the astronomers and for a library. At the same time Father Hagen outlined his historical, technical work "The Variable Stars" in which he brought together in an exemplary fashion all the standard original works relat-

ing to the things which the observer needs for his equipment and for evaluating his visual observations. The work is remarkable for the great clearness of presentation and the comprehensiveness of the material. The author deserved great credit for collecting the comments, widely scattered and difficult of access, of the numerous observers, and throughout one finds useful and valuable suggestions from the experiences of the experts in this field. Many forgotten facts were again brought to light and confirmed and elucidated by practical examples. Also the historical sequence in this work contributes much to a better understanding. For these reasons the work has a large degree of freshness and originality. For the beginner it is easy to comprehend, and for the experienced worker it is an indispensable hand book and reference work.

FATHER HAGEN AT HIS DESK IN THE VATICAN OBSERVATORY.

Star colors are the subject of another publication by Father Hagen. The color determinations of 2881 stars by P. Sestini S.J., who was an assistant of P. de Vico from 1840 to 1848 at the Observatory of the Roman College, served as a basis for this publication. These observations were published in a very inconvenient form and nearly remained unknown. Father Hagen put them into a new arrangement after he had observed all the stars himself and in addition to Sestini's color estimates he also published his own and those of Potsdam, Osthoff and Krüger. As Professor Hertzsprung assured the writer, the greatest value of this publication lies in Father Hagen's own estimates.

Hagen's many-sidedness found expression in still an entirely different field. In his work "La Rotation de la Terre, ses preuves mecaniques anciennes et nouvelles" he not only has given the history and theory of all the earlier mechanical proofs of the earth's rotation but also has de-

vised new experiments and had them performed. His experiments with the isotomeograph, a kind of torsion balance, are based on the constancy of the moment of momentum in the rotation of a body with variable momentum of inertia around a vertical axis. In the lowest vault of the photographic tower is suspended a horizontal girder, weighing 80 kilograms and 8.5 meters long, from the middle with steel wires 5.25 meters in length. Along this girder two small carriages loaded with 90 kilograms of lead can be systematically moved from the middle to the ends and vice versa. The effect was always as expected: at the centrifugal movement of the carriages the girder began to turn in the direction of the hands of a watch, and at the centripetal movement, in the opposite direction. Out of the period and the amplitude of the torsion-oscillations the angular velocity of the earth's rotation could be determined exactly quantitatively.

Hagen gave a second mechanical proof by means of Atwood's machine whereby he could diminish at will the large acceleration which is the cause of many disturbances in the usual experiments with falling bodies. He had at his disposal the well of a staircase of 23 meters in height; above it was a stone floor with a round opening through which the falling weight came into a closed space. The mean easterly deviation resulting from 66 trials agreed with the theoretical value within one per cent. Thus again the quantitative demonstration of the earth's rotation was accomplished.

In the last year of his life Father Hagen directed attention to the effect that the gradual elliptical motion of the Foucault pendulum could be considered as a natural consequence of the earth's rotation and that it represented a proof of this rotation in itself.

At the time of the installation of the 16-inch telescope Father Hagen had already thought out a complete observing program. Up to this time, following Herschel's method, the brightness of the luminous nebulae was expressed in words and symbols. Because of his well trained and especially sensitive eye he decided to carry out the plan of estimating the brightness of all the nebulae of Dreyer's *New General Catalogue* according to a numerical scale. The results of this research, arranged according to zones, were published in 1922, 1925, and 1927 in three parts, entitled "Preparatory Catalogue for a Study of the Nebulae." The General Catalogue was prepared by Dr. Frederich Becker and published in 1928. According to the opinion of expert astronomers this undertaking can be considered as completely successful and it is now generally admitted that we have in this catalogue a first class piece of observing.

Simultaneous with the observation of the luminous nebulae the so-called dark nebulae that were in the same neighborhood were noted and their darkness estimated according to a scale of five grades. These dark nebulae, which in most cases lie at the limit of visibility, had first attracted his attention while he was making observations for the Atlas of Variable Stars. From time to time it was noted by a card that the region of a variable star seemed to be enveloped in a faint nebula. The

repetition of these cards under very different circumstances led to the conclusion that the cause could only be of a cosmic nature. During his investigation of the nebula of the N.G.C., especially during the war when Rome was kept dark, he came to the conclusion that the entire sky outside of the Milky Way was covered with grey clouds. So the plan ripened into a survey of the whole sky for the purpose of cataloging the dark nebulae and of locating them by means of their galactic coördinates. This work of the last ten years of his life was practically completed at his death with the exception of one gap caused by persistently unfavorable weather in March and April. Father Hagen tried in vain to find co-workers in the southern hemisphere to aid in the survey for the dark nebulae.

We know how, at first, the reality of the dark nebulae was doubted and how Father Hagen always insisted on their existence with an unshakable conviction which his sharp and experienced eye had furnished him for decades. Gradually the matter became clearer and the number of those who are ready to admit their reality is increasing. Father Hagen took great pleasure in the last year of his life in a partial triumph of his views.

At the beginning of March Father Hagen caught a cold. Catarrh and fever were the result. With all his will-power he tried to resist the physical weakness that was slowly approaching, because he wanted, by all means, to begin on the nineteenth of March (after full moon) to complete the gap in his work. But on the eighteenth of March the fever went so high that he had to be taken to the Collegium Germanicum. From there they took him, at his own request, on the twelfth day of June into the novitiate of Galloro (Ariccia) and there in the pure and fresh mountain air he gradually felt better. However, his active spirit could not rest; he corrected the proof sheets of the fourth part of his Synopsis and the manuscript of the "Miscellanea VI" of the publications of the Observatory; he even wrote an article concerning the Foucault pendulum experiment.* This article gives evidence of the surprising freshness of his mind. Because of his never failing optimism, he hoped to be back at his observatory again by the end of August. But in the first part of August his state of health grew worse and on the nineteenth of August nephritis set in and he had to be taken to the Sanatorium Quisisana in Rome. Soon all hope disappeared and on the fifth of September he departed this life quietly and piously, as he had lived, in peace with God and mankind. Enemies this peaceful, friendly priest had none, but he had numerous friends and admirers. How highly, not only as a scientist but also as a noble and kind man, he was esteemed was demonstrated by the hearty congratulations that came to him from all parts of the world on his eightieth birthday.

Father Hagen was a born observer and organizer and was endowed with an amazing capacity for work. With his clear and methodical

*Cfr. Popular Astronomy, XXXVIII, (1930), 301-7.

mind he knew how to choose his working program in such a manner that it could be finished during his lifetime and could take full advantage of the means and energy that were available. "The most important part of his astronomical work" so he says himself "is the program, as is generally the case with every undertaking. To set up such a program and to adhere to it appears to be a very rare talent. How a good observing program is to be made up is shown in the first place by the great works which have been completed; for example, those of Lacaille and Lalande, of Bradley and W. Herschel, of Piazzi and Schiaparelli, of Bessel and Argelander, of W. and O. Struve, and of Gould and Keeler. The works which they left have two distinguishing features. They represent a real need and are completed within the limits set." (*Die Veranderlichen Sterne I*, Kap. V, das Beobachtungsprogramm.)

These words typify the man at his own work and therefore Father Hagen's name will be placed among the great astronomers of his time with everlasting fame.

On November 24, 1902, Father Hagen became a citizen of the United States; in 1906 he was appointed to the Socio Ordinario dell Pontificia Accademia della Scienze; in 1908 as an associate member of the Royal Astronomical Society, and in the same year as a member of the Kaiserlichen Leopoldinischen Carolinischen Akademie der Naturforscher; in 1922 to membership in Socio Straniero della Reale Accademia dei Lincei. In addition to these he was a member of many other astronomical and mathematical organizations. In 1921 he received Doctor Philosophiae h.c., from the University of Bonn, and in 1927 Doctor Theologiae h.c., from the University of Münster. In 1926 he received at a very imposing meeting of the Accademia della Scienze the gold medal for astronomy, and on the fifth of May, 1927, on the occasion of his eightieth birthday a golden medal of the Holy Father.

Specola Vaticana.

FORTY-FOURTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY

(Continued from Vol. XXXVIII, page 601.)

ABSTRACTS OF PAPERS

NOTE ON THE SPECTRUM OF MU CEPHEI.

By D. B. McLaughlin.

In June, 1930, it was noticed that Mu Cephei was unusually bright. Eight spectrograms were taken at Ann Arbor, from June 24 to August 24. These show definite emission at Hγ and Hδ. The emission began to fade about July 15 and by August 17 it had disappeared from Hγ, leaving absorption in its place. The emission lines are displaced to the red, relative to the absorption spectrum, by an amount equivalent to

3.5 km/sec. The absorption spectrum appears to be of class K5, but the continuous spectrum is very weak in the shorter wave-lengths.

The absorption velocities during the interval of observation show a slow decrease, approaching closely the minimum value observed on Lick spectrograms in 1911. Bright maxima observed by Lau in 1911 suggest a correlation of light and velocity curves similar to that for α Orionis, with light maximum occurring a little before velocity minimum.

NOTE ON THE SPECTRUM AND RADIAL VELOCITY OF RHO 47 LEONIS.

By Roy Marshall.

A set of 17 Ann Arbor single-prism spectrograms of the 1930 season has been measured for identification of lines and determination of radial velocity. The spectrum (Bop) is remarkable for the great number of measurable lines. A total of 54 lines of H, He I, Si IV, Si III, O II, C II, N II, Mg II, Ca II, and S III (?) were identified in the region from 3889 A to 4922 A, some lines being confirmed from previous work and some announced for the first time. The anomalous character of the K line of Ca II was confirmed, but the H line was too much involved in the wing of Hϵ to be measured.

The radical velocity was determined from 52 lines, as well as from a selected list of 15 previously used by B. H. Dawson. Dawson's velocity from 1913-1914 plates was +41.1 km/sec for the general lines and +1.7 for the K line. D. W. Lee's Ann Arbor velocity of 1923, announced as +57.2, was found by the present writer to be in error because of incorrect reductions to the sun; the velocity which should have been announced at that time is +43 for the general lines and +14 for the K line. The present writer obtained a velocity of $+46.6 \pm 0.6$ for all identified lines, and $+45.9 \pm 0.7$ for the selected list of 15. The velocity of the K line on these plates is $+8.8 \pm 1.7$. It may be said that, while the spectrum is of such a character that wide apparent variation between plates is found, the velocity of the center of mass of the star is constant.

THE STRUCTURE OF THE SOLAR CHROMOSPHERE.

By D. H. Menzel.

From a study of photographs of the flash spectrum, the following characteristics of the chromosphere were ascertained—temperature, density, density gradient, composition, and state of ionization. Milne's theory of a quiescent atmosphere was found to be inadequate. The evidence points to turbulent motion of the chromospheric gases as the agency of support, as suggested by McCrea. The amount of turbulence increases with height. (The paper will shortly appear in full in the *Publications of Lick Observatory*.)

TURBULENCE AS A UNIVERSAL CHARACTERISTIC OF STELLAR ATMOSPHERES.

By D. H. Menzel.

The turbulence of the chromosphere (see preceding paper) increases with height above the photosphere. The gases will be ascending over the hotter areas and descending over the cooler ones. Though most of the Fraunhofer absorption occurs in levels below the chromosphere, it appears likely that the above-mentioned circulation may give rise to slight displacements of the absorption lines. Furthermore, since the ascent and descent of the various gases will be controlled at least partially by radiation pressure, we might expect the resultant displacements to be a function of excitation potential. It is likely that the line displacements found by St. John (after allowing for the relativity shift) are caused by such an action.

In Cepheid variables, whose photospheric pressures are the lowest of all, we reach an extreme case. It seems most probable that the systematic differences between the radial velocity curves derived from lines of low, intermediate, and high excitation potentials (discovered by Curtiss and Rufus and attributed by them to difference of atmospheric level) arises from action of this sort. Furthermore, since variation of surface temperature would lead, very likely, to variation in the turbulence and resultant change in the position of the absorption lines, it is reasonable to suppose that part, at least, of the observed velocity variation of the Cepheids occurs in this manner. Whether or not all of the variation can thus be accounted for cannot be decided definitely, in the absence of quantitative estimates, though it appears improbable.

THE NEW DOUBLE SLIDE CAMERA FOR THE 40-INCH YERKES REFRACTOR.

By G. W. Moffitt.

Description of a new camera so designed as to expedite the observational work of stellar parallax determinations with the 40-inch telescope.

RECENT DETERMINATIONS OF STELLAR PARALLAX WITH THE 40-INCH YERKES REFRACTOR.

By G. W. Moffitt.

Parallaxes of thirty-one stars are given, the method of reduction being the same as for earlier Yerkes determinations. Exposure times have been materially reduced through changes in development. Evidence is found favoring somewhat stronger images, and the most recent series of plates show a decrease in the probable error of the results.

A NEW WASHINGTON CATALOG.

By H. R. Morgan.

This catalog, now in preparation for the press, and resulting from observations on the 9-inch transit circle at the Naval Observatory from 1913 to 1926, contains 2500 fundamental stars and 7500 fainter or "intermediary" stars which are uniformly spaced in the sky from +90° to —30° declination. The observations were reduced as an independent system, and a provisional comparison (given in a table) showed that the declination system of this instrument agrees closely with the revised fundamental catalogs, the maximum deviation being 0".3.

SOME QUANTITATIVE ASPECTS OF THE FALL OF METEORS.

By F. R. Moulton.

Permanent members of the solar system can enter the earth's atmosphere only with a speed between 7 and 50 miles per second. The following illustrative results are for a speed of 10 miles per second.

1. The kinetic energy to be accounted for is equivalent to 55,000° F for specific heat unity.

2. The atmospheric pressure per square inch at altitude of 50 miles is 3 pounds; 30 miles, 200 pounds; 14 miles, 3100 pounds; sea level, 50,000 pounds ($v = 10$ miles per second).

3. Total resistance on iron sphere weighing 1750 pounds at altitude of 50 miles is 14 pounds; 30 miles, 900 pounds; 14 miles, 14,000 pounds; sea level, 230,000 pounds ($v = 10$ miles per second).

4. Ratio of resistance to weight of an iron sphere weighing 1750 pounds at altitude of 50 miles is 0.8; 30 miles, 50; 14 miles, 800; sea level, 13,000.

5. Rate work is done on iron sphere weighing 1750 pounds at altitude of 50 miles is 13,500 horse power; 30 miles, 8,400,000 h.p.; 14 miles, 135×10^6 h.p.; sea level, 22×10^8 h.p. ($v = 10$ miles per second). Rate work done is proportional to v^3.

6. Velocity of surface impact of iron sphere weighing 125 tons and falling at angle θ with the vertical is: $\theta = 0$; $v_0 = 3.8$ miles per second; $\theta = 30°$, $v = 3.2$ mi/sec; $\theta = 60°$, $v = 1.1$ mi/sec; $\theta = 75°$, $v = 0.2$ mi/sec.

7. Pressure per square inch on meteors entering rock at $v = 1$ mi/sec is 500 tons; $v = 5$ mi/sec, $P = 12{,}500$ tons; $v = 10$ mi/sec, $P = 50{,}000$ tons; $v = 20$ mi/sec, $P = 200{,}000$ tons.

8. Rate of work done per square inch on meteor entering rock at $v = 1$ mi/sec is 2,400,000 h.p.; $v = 5$ mi/sec, 300×10^6 h.p.; $v = 10$ mi/sec, $2{,}400 \times 10^6$ h.p.; $v = 20$ mi/sec, $20{,}000 \times 10^6$ h.p.

The conclusions are that (1) small meteors are consumed in the atmosphere; (2) larger meteors are retarded so much in the upper atmosphere that the pressures they encounter do not rupture them and hence

they do work largely on the atmosphere and survive to the surface; and (3) meteors weighing 1,000 tons or more reach the solid earth with such velocity that the pressures generated are sufficient to completely rupture them and the energy given up by the time the velocity has been reduced to five miles per second is sufficient to entirely vaporize them. Hence for meteors to reach the earth's surface and survive, their masses must be above certain minima and below certain maxima, depending upon the velocity with which they enter the atmosphere.

REDETERMINATION OF THE ELEMENTS OF GALACTIC ROTATION.

By J. A. Pearce.

A simultaneous solution for the solar motion, galactic rotation, and K term for 680 O-B5 stars whose probable errors are less than ± 3.0 km/sec, gave the values $V_0 = 22.0$ km/sec, $A_0 = 281°$, $D_0 = +40°$, $K = +3.5$ km/sec, $\tau A = +4.3$ km/sec, $l_0 = 321°.5$. With this apex the elements of galactic rotation and the K term were determined from 790 stars whose probable errors were less than ± 5.0 km/sec.

The strong K-term characteristic of the stars brighter than $5^M.50$ precludes a definite determination of the galactic rotation from them. The O-B2 stars fainter than $5^M.50$ clearly demonstrate a rotation about a distant centre in galactic longitude $l_0 = 327°.7 \pm 2°.5$, with a coefficient $A = +0.016 \pm .001$ km/sec per parsec from the sun.

The independent determinations of l_0 from globular clusters, radial velocities of stars other than O and B, velocities of interstellar calcium, and radial velocities of the O-B2 stars give a weighted mean value of $l_0 = 328°.7 \pm 0°.8$.

PRELIMINARY STUDY OF A NEW PANCHROMATIC PLATE.

By Nicolas Perrakis.

The new Guilleminot panchromatic plate has been investigated by spectrograms of a standard lamp at well determined distances from the spectrograph.[1] Eight spectrograms were made on each plate under the same conditions of exposure time and development. Measurements were made with Fabry's microphotometer and Challonge's photoelectric microphotometer.

The curve of density and wave-length shows three maxima, here given in the order of decreasing magnitude: near 6400 A, near 5800 A, and near 4650 A. The variation with wave-length of the contrast factor (γ) of the plate can be summarized as follows:

γ	1	2	3	5 (max.)	2.6
λ	4000 A	4300	6200	6800	7150

The contrast of this plate is greatest near 6800 A, and this explains the fine structure of the images of the corona obtained by Lallemand[2] dur-

[1] Nicolas Perrakis, *C. R.*, **190**, 1493, 1930.
[2] A. Danjon, *l'Astronomie*, **44**, 193, 1930.

ing the eclipse of May, 1929, with this plate and a red Jena screen of mean wave-length 6800 A.

RECENT DEVELOPMENTS IN THE SUN-SPOT CURVE AS DEDUCED AT THE U. S. NAVAL OBSERVATORY.

By G. H. Peters and N. E. Wagman.

This paper is supplementary to that presented at the Ottawa meeting in 1929, and the sun-spot curve has been extended to cover the succeeding year. After an abrupt decline, the smoothed curve has risen to form another peak. This rise was caused by the great solar activity observed in December, 1929. Only slightly, in December, 1925, was this activity exceeded during this maximum. These two peaks, December, 1925, and December, 1929, are the conspicuous features of the plot of monthly mean daily areas. Other centers of lesser activity occur at intervals of approximately 16 months. The activity is now lowest since January, 1925, when the sharp rise of the current maximum began. This indicates that the sun-spot cycle is well on its way toward minimum which is due in 1934. If the 16-month period persists, another upturn may be expected early in 1931. By comparison with curves of past maxima it is seen that the present maximum belongs to the type characterized by a long, flattened top, rather than by a well defined peak and greater intensity. Similar maxima occurred in 1805, 1830, and 1906.

MEASUREMENTS OF ULTRA-VIOLET SOLAR RADIATION DURING THE PAST SIX YEARS.

By Edison Pettit.

The measurements were begun at the end of May, 1924, and have been continued on every clear day with the same apparatus, save for mechanical improvement, to the present time, except for the winter of 1924-1925 when the apparatus was being re-built. The same quartz lenses and gold and silver films upon which the measurements depend, were used throughout this period. Tests of the transmissions of the films show a stationary condition in spite of their long exposure to sunlight.

The unit of the measurements is that for June, 1924. Since that time the highest values of the monthly means have been November, 1925, 1.57, February and April, 1927, 1.51, and January, 1930, 1.52. The lowest values of the monthly means have been June, 1924, 1, January, 1928, 1.18, September, 1928, 1.12, June and November, 1929, 1.19, and April, 1930, 1.15. The daily values and monthly means are being published in the *Bulletin for Character Figures of Solar Phenomena.*

A plot of the three-month running averages of ultra-violet solar radiation against the number of sun-spot groups treated in like manner shows considerable correspondence except for the year June, 1928, to June, 1929, during which interval the curves run counter. There ap-

pears to be no instrumental reason for this which can be seen at the present time.

TIME OF A SOLAR ECLIPSE FROM A SOUND FILM.

By Edison Pettit and S. B. Nicholson.

The position of the Mount Wilson station for the solar eclipse of April 28, 1930, at Honey Lake as determined by a careful survey with instruments loaned by the astronomical department at Berkeley was longitude W 120° 15′ 30″, latitude N 40° 8′ 20″, elevation 4000 feet.

During the eclipse moving pictures with sound record were made by the Fox Movietone News. This film shows a continuous record of the eclipse near totality with twenty-four pictures per second and also a record of the time counts which one of us made for the convenience of the observers at ten second intervals during the minute preceding totality.

A determination of the time of mid-totality from this film gave $19^h\ 5^m\ 51^s.4$ G.C.T. The predicted time was $19^h\ 5^m\ 53^s.1$. The predicted duration was 1.4 seconds while the observed value was 1.2 seconds. Thus it appears that the eclipse occurred 1.7 seconds earlier than predicted and the duration was about 0.2 second less.

WILLIAM HERSCHEL'S FIFTY-TWO EXTENSIVE DIFFUSED NEBULOSITIES.

By Dorothea K. Roberts.

Review of William Herschel's work on diffused nebulosities; of the photographic search for them by Isaac Roberts; and of their visual observation by Hagen, Franks, and others. Hagen's suggestion that failure to photograph these nebulosities may lie in the development of the plate leads one to hope that researches in photographic technique may yet bring success.

LAG OF PHASE AT HIGH LEVELS IN ZETA GEMINORUM.

By W. C. Rufus.

Systematic differences in line displacements at different atmospheric heights in several Cepheids have been found at Ann Arbor and partly confirmed elsewhere. Results in the case of Zeta Geminorum have been questioned by H. F. Henroteau and by V. Hase.

High, intermediate, and low velocity curves were formed by the writer which show resemblances in their main features. Velocity-difference curves, high-minus-low and high-minus-intermediate, were used as test for a lag of phase at high level. Negative differences predominate before maximum velocity and positive afterward. Using data by Hase, similar results were obtained. The distribution of the differences with respect to phase gives fairly smooth curves with amplitudes of about 12 km/sec, which is greater than one-third that of the velocity curve.

An ionization effect on line displacements was also isolated with an amplitude of about 10 km/sec.

NOTE ON SPACE-REDDENING IN CASSIOPEIA.

By C. Schalén.

The author finds a rather pronounced relation between distance and color excess for 22 stars in the direction of the open cluster NGC 663 in Cassiopeia. Spectral types, photographic magnitudes, and distances for the stars in question are found in my paper in *Upsala Meddelande*, **37**, 112; the color indices were determined by Wallenquist (*Upsala Medd.*, **42**, especially Table XI). The selective absorption determined from these stars should amount to $0.26 \pm .06$ (m.e.) magnitude per 1000 parsecs (when the distances are corrected for a general absorption of 0.5 magnitude per 1000 parsecs found in *Upsala Medd.*, **45**). This is in good agreement with the results of Trumpler and van de Kamp. Details will be published soon as a *Meddelande* from Upsala.

INTERNATIONAL BROADCASTS OF COSMIC DATA.

By James Stokley.

In coöperation with the American Section of the International Scientific Radio Union, Science Service is now gathering certain cosmic data, which are broadcast daily at 21 hours G.C.T. from station NAA on a frequency of 16,060 kc, as an addition to the daily weather message directed at the French station FYL (Lafayette). The data given include solar constant, terrestrial magnetism, sunspots, and aurorae, and are furnished through the courtesy of the Smithsonian Institution, the Carnegie Institution of Washington, Department of Terrestrial Magnetism, and the Mt. Wilson Observatory, and the section on terrestrial magnetism and seismology of the U. S. Coast and Geodetic Survey.

NOTE ON THE SPECTRUM OF 7 EPSILON AURIGAE.

By O. Struve and C. T. Elvey.

A study of the residuals in radial velocity for individual lines (in the sense, line minus mean, for each plate) reveals the following facts: (1) In the interval J.D. 2425100-6200 the residuals are not distributed at random; certain lines like Mg^+ 4481 give negative values up to J.D. 2425700 and positive values up to J.D. 2426200, the curve being roughly sinusoidal with an amplitude of over 20 km/sec. The line Sr^+ 4215 shows the same peculiarity but the amplitude is smaller. Many lines, like Ti^+ 4468, show no appreciable amplitude, while other lines have their phases reversed; such are Fe^+ 4583, which shows positive residuals in the beginning and negative residuals after J.D. 2425700, and the hydrogen lines. (2) The spectral peculiarities in this star started about 250 days before the beginning of the eclipse and lasted approximately 100 days after the end of the eclipse.

Our measurements refer in all cases to the most intense portion of the unsymmetrical lines, no attempt having been made to measure separate-

ly the components observed by Adams and Sanford. However, many of our plates taken with the dispersion of three prisms agree with their description of the lines.

We have obtained two spectrograms with three-prism dispersion on August 12 and 19, 1930. Most of the lines were symmetrical, but a few, e.g. Ti^+ 4443 and Ti^+ 4468 were still unsymmetrical (sharp on violet side), confirming the evidence from the residuals that the abnormal effects in the spectrum of this star have outlasted the eclipse. The line Mg^+ 4481 is symmetrical. The hydrogen line beta is much weaker at present than it was during the eclipse. The width of the line at an absorption of 70 per cent is 0.8 A as compared with 1.4 A during the eclipse.

ON THE ABSORPTION OF LIGHT IN SPACE.

By P. van de Kamp.

Published in *The Astronomical Journal*, No. 945.

THE SPECTRUM OF P CYGNI.

By W. J. Williams.

This study is based on 88 one-prism spectrograms taken between 1914-1929 at the Detroit Observatory.

The work of Frost, Merrill, and Curtiss showed that the displacements of the hydrogen absorption lines increase with wave-length. The study confirms this and shows that the displacement of any line depends on the density (and width) of the accompanying emission line. The correlation between the displacement of the absorption and the width of the emission is linear. Red absorption components were measured on many emission lines. The true center of the hydrogen absorption line is hidden by the emission and has not been measured.

Twenty-eight lines due to helium were measured. Each series behaved like the Balmer series. Lines due to NII, OII, SiII, SiIII, SiIV, MgII (4481), and CaII (K, stationary) were also measured.

The emission lines gave a velocity of —9 km/sec for the radial velocity of the star. No indication of a binary character was found.

The explanation is offered that the star is ejecting its atmosphere. A computation shows that the fraction of mass thus ejected in one year is of the order of 10^{-12}.

A METEOR OBSERVATORY.

By C. C. Wylie.

The most important unsolved problem in meteoric astronomy is the velocity of meteors. We, therefore, recommend the installation of photographic equipment, similar to that used by Elkin at Yale, at the observatory and at an auxiliary station. As one can photograph only the brightest meteors, it is advisable to have some lenses of high quality,

and use the plates for other purposes, for example for sky patrol or photometric work.

For ordinary shooting stars, a visual method of determining the velocity must be worked out. We plan to use first one or more fixed mirrors, and also a rocking mirror, at the observatory; and fixed mirrors at the auxiliary station or stations. The observations at two stations using fixed mirrors give the real path of the meteor through the atmosphere. The trail as seen in the rocking mirror is deflected, and a comparison of this trail and that in the fixed mirror gives the velocity.

WILLIAM HERSCHEL'S 52 EXTENSIVE DIFFUSED NEBULOSITIES*

By MRS. ISAAC ROBERTS.

The existence of faintly luminous extensive nebulosities scattered throughout the heavens with "an exuberance that exceeds all imagination . . . , obtruded itself already on the knowledge of astronomers"[1] in the early part of the XIXth century.

In his remarkable memoir, relating to the Construction of the Heavens, presented to the Royal Society, London, on June 29, 1811, Sir William Herschel gives the positions and description of 52 Extensive Diffused Nebulosities that "occasionally fell under his observation,"[1] during his sweeping of the heavens from 1783 to 1802; but, until the end of the XIXth centry, no systematic effort was made by any observer of the heavens in order to re-discover these hidden treasures of astronomy which Sir William Herschel had seen with his 20-foot reflector.

On November 14, 1902, an amateur astronomer and a pioneer in the field of celestial photography, the late Dr. Isaac Roberts, presented to the Royal Astronomical Society of London, the results of his systematic photographic survey of "Herschel's Nebulous Regions," but, alas! no trace of Herschel's Extensive Diffused Nebulosities, as they are now known, was shown on the Starfield plates.

On July 2, 1928, I had the joy of completing and publishing, in commemoration of the centenary of the birth of my husband, the late Dr. Isaac Roberts (1829-1904), an atlas entitled, *Isaac Roberts' Atlas of 52 Regions, A Guide to Herschel's Fields*, a presentation copy of which is held at the disposal, in memory of the late Dr. Isaac Roberts and as far as the limited edition of this *Atlas* permits, "of any observer of the heavens who will earnestly endeavor to observe Herschel's Fields, with

*Paper read at the Forty-fourth Meeting of the American Astronomical Society, Chicago, Illinois, September 3 to 5, 1930.

[1] From Herschel's Paper.

the scientific means and method at his disposal."[2]

In this *Atlas,* 50 of the photographic plates of Herschel's Regions obtained at Starfield, Crowborough Sussex, with the 20-inch reflector, and 10 of the corresponding plates, obtained simultaneously with the 5-inch Cooke lens, are reproduced on a scale of 2.15 diameters; the center of each Herschel Field, as well as the guiding star for each field, used by the Reverend J. G. Hagen, is marked on each chart. In their preliminary form, these charts, from the originals obtained at Dr. Isaac Roberts' Observatory, enabled the Director of the Vatican Observatory speedily to locate and observe visually with his 14-inch refractor, Herschel's 52 Extensive Diffused Nebulosities, thus re-discovering what William Herschel had discovered one hundred and fifteen years before.

Other observers, in England, in Germany, and elsewhere have succeeded in visually observing some of Herschel's Nebulous Fields. Among the observers is Mr. W. S. Franks, F.R.A.S., the faithful assistant of the late Dr. Isaac Roberts; but hitherto the efforts made at various observatories in photographing Herschel's 52 Extensive Diffused Nebulosities do not appear to have been successful.

An important step toward the solution of the problem of Herschel's Diffused Nebulosities is presented by the Baxendall Nebulosity in Aquarius, close to the bright Cluster M2, which Nebulosity the keen eye of the observer has seen in the heavens but of which no impression has been obtained on the photographic plate. In this respect, Father Hagen writes[3] "It seems quite possible that the secret lies in the developer. The light of extensive nebulosities may well have impressed many plates, but may have remained latent, because the specific developer was not applied."

May I respectfully make the request that all American astronomers, interested in Herschel's Nebulous Fields and who are endeavoring to take photographs of these objects, join in bringing their problem to the attention of Mr. George Eastman of Rochester and to the savants under his direction.

May we express the hope that there will soon be discovered the specific developer which will reveal on the photographic plate the images of Herschel's Extensive Diffused Nebulosities, and then, again, as in Herschel's times, these nebulosities "will throw some new light upon the Organization of the Celestial Bodies" and upon "the Construction of the Heavens."[4]

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[2] *Publications of the Astronomical Society of the Pacific,* April, 1930, pages 110-112.

[3] On the Significance of Baxendall's Nebulosity, *M.N.R.A.S.,* 1930 January.

[4] From Herschel's Paper.

PHENOMENA FOR 1931

By LOUIS BERMAN.

Eclipses.

The year 1931, although presenting five eclipses, will be of less than average interest to astronomers in general, since all three eclipses of the sun are partial. The following information concerning the circumstances of the eclipses together with Figures 1, 2, and 3 is taken from the *American Ephemeris and Nautical Almanac*.

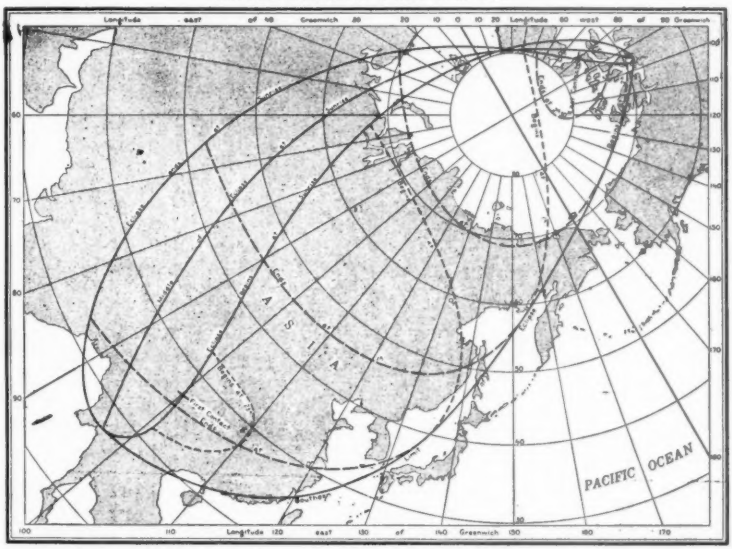
I. A Total Eclipse of the Moon, April 2, 1931.

The beginning generally visible in the western part of the Pacific Ocean, Asia, Australia, the Indian Ocean, Europe, and Africa; the ending generally visible in Asia except the eastern part, the Indian Ocean, Europe, Africa, the Atlantic Ocean, and the eastern part of South America.

Circumstances of the eclipse:

	G. C. T. d h m
Moon enters penumbra	April 2 17 27.2
Moon enters umbra	2 18 23.2
Total eclipse begins	2 19 22.3
Middle of eclipse	2 20 7.4
Total eclipse ends	2 20 52.6
Moon leaves umbra	2 21 51.7
Moon leaves penumbra	2 22 48.0

PARTIAL ECLIPSE OF APRIL 17-18, 1931.



Note: The hours of beginning and ending are expressed in Greenwich Civil Time.

Figure 1.

The diameter of the earth's shadow at the time of eclipse will be 1.5 times greater than the moon's diameter. To obtain the local time at the place of observation subtract the longitude from the Greenwich Civil Time of prediction.

II. A PARTIAL ECLIPSE OF THE SUN, APRIL 17-18, 1931.

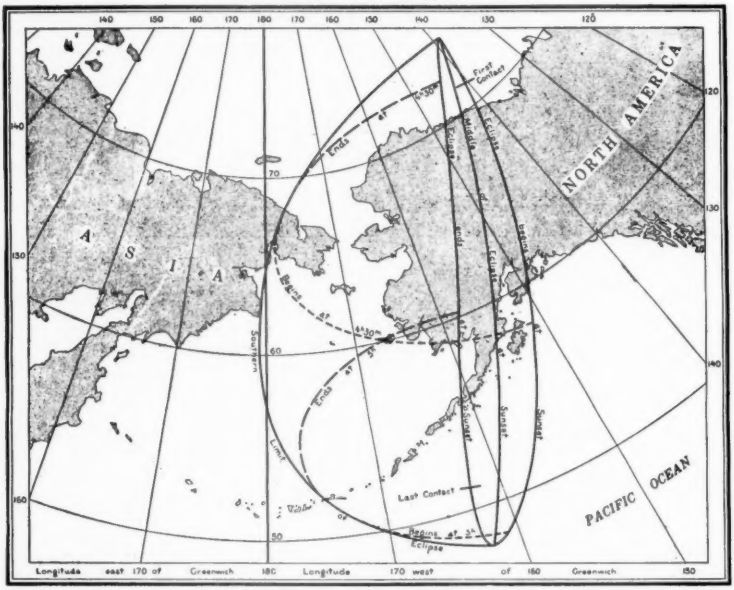
Circumstances of the eclipse:

	G. C. T. d h m	Longitude from Greenwich ° ′	Latitude ° ′
Eclipse begins	April 17 22 57.4	—100 15	+26 52
Greatest eclipse	18 0 45.1	— 58 44	+61 38
Eclipse ends	18 2 32.3	+ 80 1	+76 6

This eclipse will be visible over nearly all of Asia, beginning off the eastern coast and ending in the west. The eclipse of greatest magnitude at which time the solar disk will be half covered by the moon, occurs at sunrise in the Ural Mountains.

III. A PARTIAL ECLIPSE OF THE SUN, SEPTEMBER 12, 1931.

PARTIAL ECLIPSE OF SEPTEMBER 12, 1931.



Note: The hours of beginning and ending are expressed in Greenwich Civil Time.

FIGURE 2.

Circumstances of the eclipse:

	G. C. T. d h m	Longitude from Greenwich ° ′	Latitude ° ′
Eclipse begins	Sept. 12 4 13.1	+140 27	+71 18
Greatest eclipse	12 4 40.9	+152 39	+61 24
Eclipse ends	12 5 9.3	+162 29	+51 10

The entire duration of the eclipse over the eclipse area will be less than one

hour due to the fact that the penumbra of the moon's shadow will just graze the earth at Alaska. At the most the moon will encroach upon only one-twentieth of the solar disk. In Nome, Alaska, the eclipse will be seen partial on September 11 from 5:24 P.M. to 5:51 P.M. Standard Time, just about long enough for first and last contacts to be made.

IV. A TOTAL ECLIPSE OF THE MOON, SEPTEMBER 26, 1931.

The beginning visible generally in the western part of the Pacific Ocean, Asia, Australia, the Indian Ocean, Europe, and Africa except the northwestern part; the ending visible generally in Asia except the northeastern part, the Indian Ocean, Europe, Africa, the Atlantic Ocean, and the eastern part of South America.

Circumstances of the eclipse:

	G. C. T.		
	d	h	m
Moon enters penumbra	Sept. 26	16	40.7
Moon enters umbra	26	17	54.2
Total eclipse begins	26	19	5.5
Middle of eclipse	26	19	48.0
Total eclipse ends	26	20	30.5
Moon leaves umbra	26	21	41.8
Moon leaves penumbra	26	22	55.3

While hardly measuring up in usefulness to a solar eclipse an eclipse of the moon can give the following observational data: occultations of faint stars, radiometric measurements of the lunar surface during the various eclipse stages which yield important particulars concerning the composition of the lunar crust, and spectrographic measurements of the refracted sunlight which furnish information as to the amount of water vapor and transmission of radiation in the earth's atmosphere.

PARTIAL ECLIPSE OF OCTOBER 11, 1931.

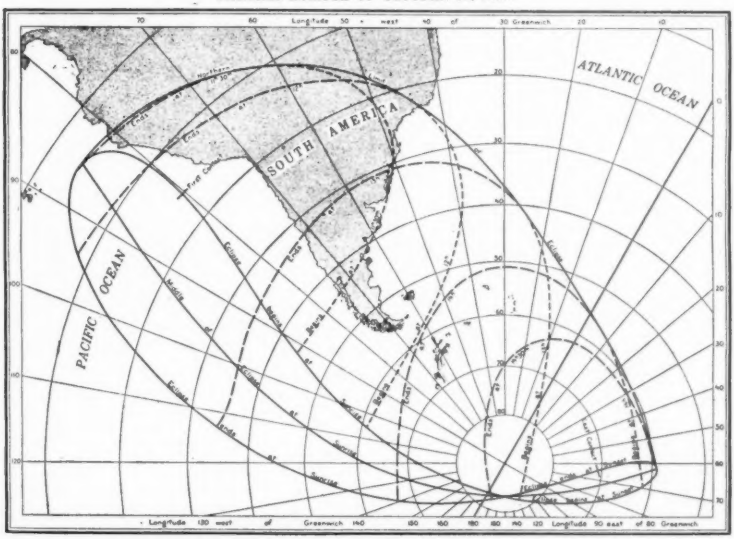


FIGURE 3.

V. A Partial Eclipse of the Sun, October 11, 1931.

Circumstances of the eclipse:

	G. C. T.	Longitude from Greenwich	Latitude
	d h m	° ′	° ′
Eclipse begins	Oct. 11 11 1.0	+ 80 24	—15 40
Greatest eclipse	11 12 55.2	+119 37	—61 22
Eclipse ends	11 14 48.9	— 64 30	—70 46

This eclipse will be visible over the southern portion of South America. At the time of greatest eclipse, which occurs in the Pacific Ocean, all but one-tenth of the sun's disk will be covered by the moon.

The Sun.

The sun will be nearest to the earth on January 3, 10^h Greenwich Civil Time. It enters the sign of Aries on March 21, $14^h\ 7^m$ G.C.T., at which moment Spring begins. Summer commences on June 22, $9^h\ 28^m$ G.C.T., as the sun is just reaching the sign of Cancer. On July 15, $5^h\ 27^m$ G.C.T., the sun will be farthest from the earth. Autumn begins when the sun enters the sign of Libra on September 24, $0^h\ 24^m$ G.C.T. Winter begins on December 22, $19^h\ 30^m$ G.C.T., as the sun enters the sign of Capricornus.

The Planets.

Since the orbits of the planets are very nearly in the plane of the earth's orbit, they will be seen edgewise along the ecliptic by an observer on the earth. The planets' own motions about the sun combined with that of the earth's motion make their apparent paths in the sky appear somewhat complicated by the addition of kinks and loops depending upon their movements relative to the earth. (In Figures 4-9 the apparent paths of the planets among the stars have been plotted on a background furnished through the courtesy of the Eastern Science Supply Co., Chart SC1.) The long arrows in Figures 4 and 5 indicate the position of Mercury at the beginning of each month; the short arrows, the position of Venus at the beginning of each month. In the remaining Figures the position of the planet is indicated for the first of the month by short arrows.

Mercury.

Beginning with the year Mercury will retrograde into the constellation of Sagittarius, reach a stationary point there on January 17, and thence move eastward; it will cross the ecliptic on February 4 at the descending node of its orbit; continuing its rapid eastward motion through Capricornus the planet will be farthest south of the ecliptic on March 6 after which it will recross the ecliptic at the ascending node in the constellation of Pisces; on April 9 it attains its greatest distance north of the ecliptic; becomes stationary near Aries on April 20 and then backs up, moving to the southwest, as it crosses the ecliptic; the planet's retrograde motion is retarded on May 12 after which it moves forward again very rapidly through Taurus, Gemini, Cancer, and Leo, finally executing a loop in its motion during August and September just before it reaches the constellation Virgo; the forward motion of the planet stops on December 11 when it reaches a stationary point and at the end of the year it will be found retrograding in Sagittarius, winding up about 33° west from where it began the year. Mercury will be at inferior conjunction on January 6, April 30, September 5, and December 21; at superior conjunction on March 16, June 29, and October 18.

Greatest Elongation East. Mercury visible as an evening star.				Greatest Elongation West Mercury visible as a morning star.			
Date 1931		Dist. from Sun ° ′	Magn.	Date 1931		Dist. from Sun ° ′	Magn.
April	10	19 27	+0.3	January	28	24 54	+0.2
August	8	27 23	+0.6	May	27	24 57	+0.7
December	3	21 19	−0.2	Sept.	21	17 52	−0.2

Venus.

In January Venus will be found about ten degrees north of Antares and moving eastward as a morning star; its motion will in fact be direct for the entire year; on January 27 the planet will reach its greatest northern heliocentric latitude and will cross the ecliptic moving from north to south on March 24; prior to that, on February 25, there will be a conjunction with Saturn; it will continue eastward as a morning object, a conjunction with Mars occurring on May 10, and it will be farthest south of the ecliptic on May 20; on July 15 the planet crosses the ecliptic passing from south to north, and on August 6 it will be in conjunction with Jupiter; the planet will finally catch up with the sun on September 8, and reappear on the other side as an evening star for the remainder of the year; it again reaches its greatest distance north of the ecliptic on September 9, finally recrossing the ecliptic on November 4, at which time it will be but a few degrees south from where it began the year; on November 19 the planet will be in conjunction with Mars, and on December 19 in conjunction with Saturn; at the close of the year Venus will be found in the constellation of Capricornus at its most southerly distance from the ecliptic. Superior conjunction occurs on September 8. The most favorable time for viewing Venus will be on the morning of February 1, when the planet will be at its greatest western elongation, 46° 55′ from the sun. At that time it will present a half-illuminated disk of stellar magnitude −4.1. Its greatest brilliancy, however, occurs at the beginning of the year when its magnitude is −4.4.

Mars.

The red planet Mars will be found moving westward into the constellation of Cancer when the year begins. In Figure 6 the path is plotted only for that period when it will be visible for observation. It will be closest to the earth on January 25, presenting a disk 14".1 in diameter, of stellar magnitude −1.1, and 61,512,000 miles away; opposition takes place two days later; on February 24 the planet attains its farthest distance north of the ecliptic; it becomes stationary on March 9 and from then on the motion is direct for the remainder of the year; it will pass through

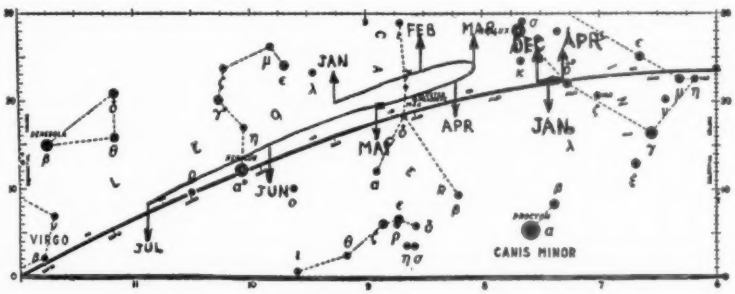


Figure 6. Apparent Paths of Mars and Pluto in 1931.

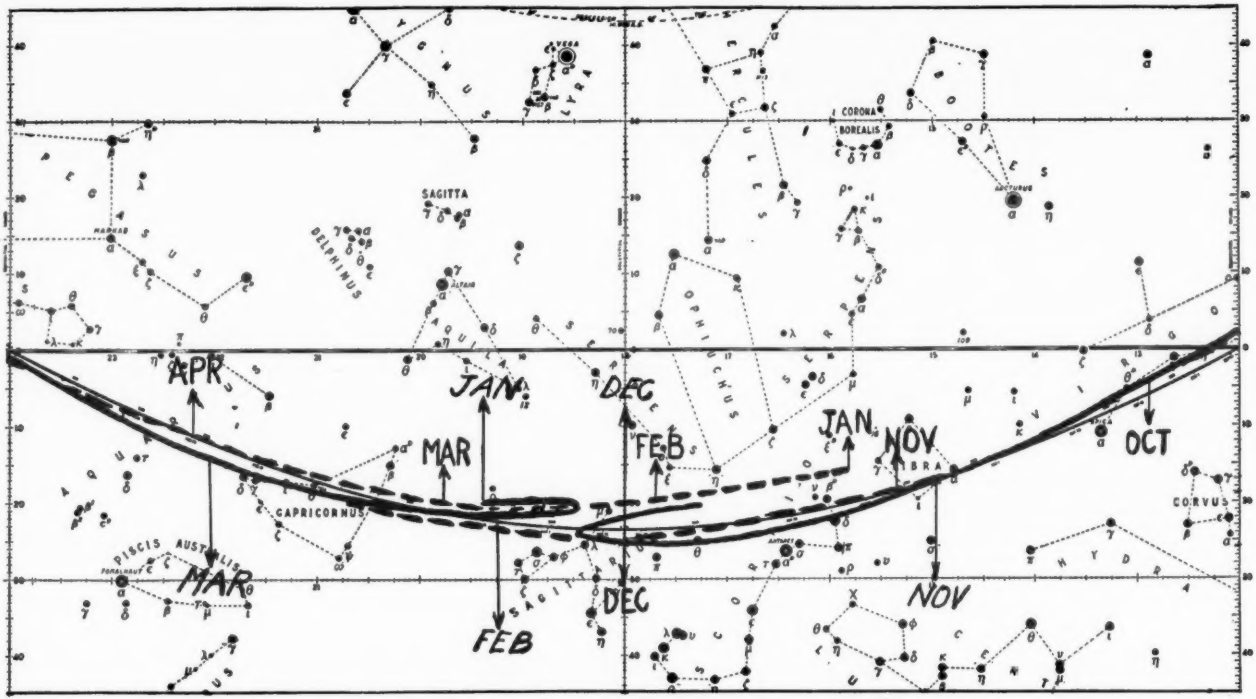


FIGURE 4. APPARENT PATHS OF MERCURY AND VENUS IN 1931.

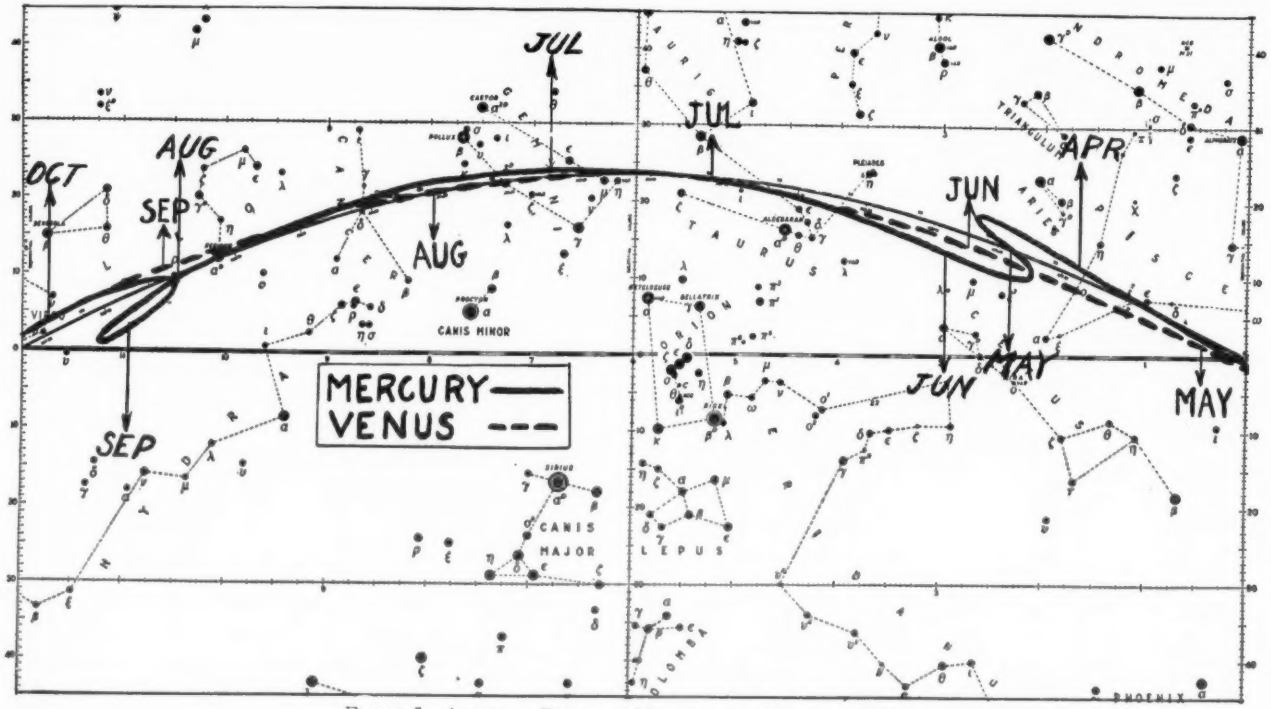


FIGURE 5. APPARENT PATHS OF MERCURY AND VENUS IN 1931.

eastern quadrature on May 2; on September 9 the planet crosses the ecliptic, moving from north to south in the constellation of Virgo; it will wind up at the close of the year in Sagittarius rather close to the ecliptic.

JUPITER.

Jupiter will be found retrograding at the beginning of the year in the constellation Gemini; on January 6 opposition takes place at which time the planet will be 391,000,000 miles distant from the earth and presenting a disk 46″ in diameter, of stellar magnitude —2.2; on March 7 the westward motion of the

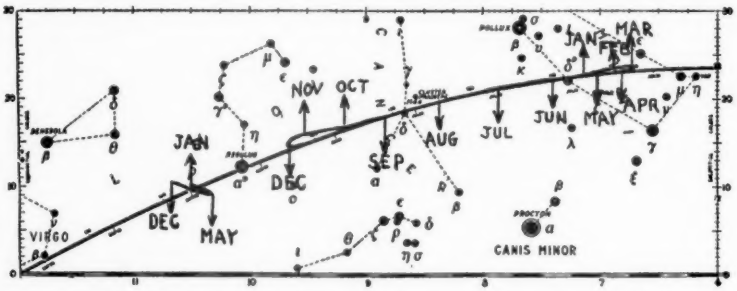


FIGURE 7. APPARENT PATHS OF JUPITER AND NEPTUNE IN 1931.

planet ceases and it moves direct from then on closely following the ecliptic; eastern quadrature occurs on April 2, conjunction on July 25, and western quadrature on November 15; finally on December 10 the planet becomes stationary, after which its motion will be retrograde up to the end of the year.

SATURN.

Saturn will begin the year not far from the constellation Sagittarius; its motion at this time will be direct; on January 5 it is at conjunction and hence farthest from the earth; the eastward motion continues until May 3 when the

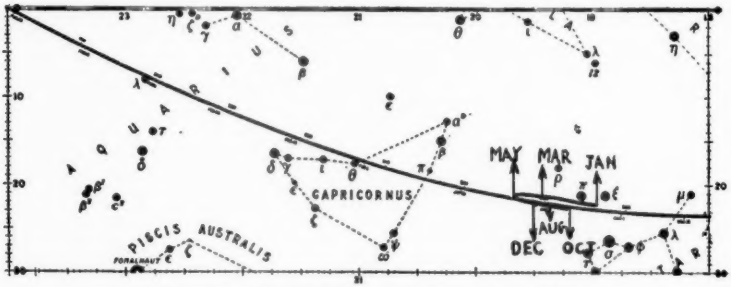


FIGURE 8. APPARENT PATH OF SATURN IN 1931.

planet turns about and moves westward; on April 13 Saturn reaches western quadrature and on July 13 it is at opposition; the retrograde motion of the planet ceases on September 21 and from then on until the close of the year its motion will be direct; eastern quadrature takes place on October 11 and thirteen days later

the planet will be found crossing the ecliptic as it moves from north to south, less than four degrees from where it started the year.

Uranus.

Uranus will remain in the constellation Pisces during the entire year. Beginning in January its motion will be direct and closely confined to the ecliptic; on January 2 it will be at eastern quadrature, on April 6 at conjunction, and on July 12 at western quadrature; it will reach a stationary point in its eastward

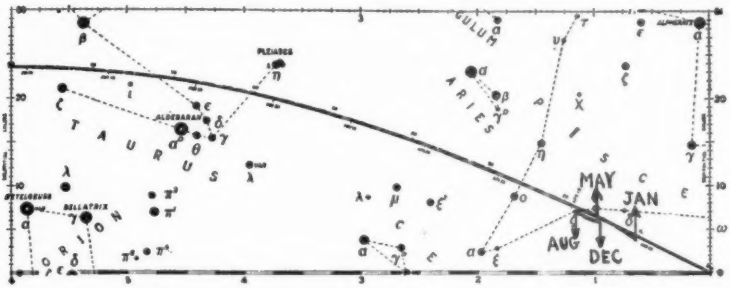


Figure 9. Apparent Path of Uranus in 1931.

motion on July 26 after which its motion becomes retrograde; opposition occurs on October 11 at which time the planet will show a greenish disk, 3".6 in diameter, hardly visible to the naked eye as a sixth magnitude star; on December 26 the planet's motion is eastward again after having accomplished a net forward gain of about five degrees in its motion for the year.

Neptune.

Neptune will be moving westward at the beginning of the year several degrees east of Regulus. It is, of course, invisible to the naked eye but is easily distinguishable even with a small telescope as a star of magnitude 7.7. On February 24 it will be at opposition; the planet becomes stationary on May 15 and thence continues eastward for the rest of the year, moving very little, however; eastern quadrature occurs on May 25, conjunction on August 29, and western quadrature on December 1; the direct motion of the planet continues until December 11 when it reaches a stationary point after which the motion is retrograde for the remainder of the year. (See Figure 7.)

Pluto.

Pluto, the ninth planet of the solar system, was discovered photographically on January 21, 1930, at the Lowell Observatory after many years of systematic search. Because of the remoteness of the planet, 3,586,000,000 miles from the earth, little is known concerning its physical characteristics at the present time. About all that can be said is that it is comparable with the earth in size, has relatively small mass, high density, and low reflecting power. The planet, of the fifteenth magnitude, can therefore be seen visually only in the most powerful telescopes. In fact, its movement among the stars is best studied photographically. Due to the fact that the revolution period of the planet is 249 years, the average eastward motion per annum is very small, being but 1°.4. It will therefore be found not far from the place of discovery in the constellation Gemini, about 10°

southwest of Pollux. The apparent motion will at first be retrograde and closely confined to the ecliptic; during the month of March Pluto will be within a few degrees of Jupiter and Mars; the object will reach a stationary point on April 5, turn about and thence retrace its course eastward for the remainder of the year. (See Figure 6.)

Occultations.

Elements for the prediction of the times of occultations of stars and planets by the moon throughout the year may be found in the *American Ephemeris and Nautical Almanac*. There will be no occultation of a star brighter than the second magnitude observable in the United States in 1931. Of very great interest, however, is an occultation of Uranus by the moon on the evening of January 24. Occultations visible at Washington, as given in the *American Ephemeris*, and those visible at Omaha, and at some other stations, computed by Wm. C. Doyle will be published as usual from month to month.

Meteors.

Increasing public interest in meteors is being evinced from year to year, largely through the efforts of amateur astronomers all over the world working in cooperation with professional observers. The approximate dates of the important meteoric showers are given in the following table:

Designation	Date of Shower	Appearance of Trails
Draconids	January 2	Slow, trains.
Lyrids	April 20	Swift, streaks.
Aquarids I	May 2-6	Swift, very long trains.
Aquarids II	July 28-30	Slow, trains.
Perseids	August 12	Swift, yellow streaks.
Orionids	October 20	Swift, streaks.
Leonids	November 14-15	Very swift, blue-green streaks.
Andromedids	November 17-27	Very slow, reddish short trains.
Geminids	December11-12	Swift, white short paths.

The Meteor Notes by Professor Charles P. Olivier will continue to be published with every issue of Popular Astronomy throughout the year. Notes will be contributed by Professor C. C. Wylie also.

For the predicted times of comet returns the reader is referred to the *British Astronomical Association Handbook for 1931*. Information concerning unexpected comet discoveries is always to be found in Professor G. Van Biesbroeck's Comet Notes which are regularly printed in this magazine. Further data regarding many other kinds of interesting phenomena for 1931 are obtainable in the above *British Handbook* as well as in the *Observers' Handbook* published by the Royal Astronomical Society of Canada.

PLANET NOTES FOR FEBRUARY 1931

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast from the western part of Capricornus to the western part of Aquarius. Its position on the first and last days of the month will be, respectively:

R.A. $20^h\ 55^m$, Decl. $-17°\ 26'$; R.A. $22^h\ 40^m$, Decl. $-8°\ 24'$.

The phases of the *Moon* will occur as follows:

Full Moon	Feb.	2 at	6 P.M.	C.S.T.
Last Quarter		9 "	10 A.M.	"
New Moon		17 "	7 A.M.	"
First Quarter		25 "	11 A.M.	"

Perigee will occur on February 3, and apogee will occur on February 18.

Mercury will be in eastern Sagittarius at the beginning of the month and during the month it will move to the eastern part of Capricornus. It will be a morning star of brightness about magnitude zero, and at the beginning of the month it will rise about an hour and a half before the sun. Its distance from the earth will vary from about 98 million miles at the beginning of the month to about 125 million miles at the end of the month. On February 1 Mercury will be in conjunction with Saturn. At this time they will be separated by a distance equal to about a tenth the diameter of the moon. On February 15 Mercury will be in conjunction with the moon.

Venus will be a morning star in Sagittarius of brightness about magnitude minus four, and it will rise about three hours before the sun. Its distance from the earth during this period will vary from about 62 to about 81 million miles. On February 1 Venus will be at greatest elongation west of the sun (46° 55′), on February 13 it will be in conjunction with the moon, and on February 25 in conjunction with Saturn.

Mars will be an evening star in eastern Gemini of brightness about magnitude minus one. Its apparent motion among the stars will be retrograde, and its distance from the earth during this period will vary from about 62 to about 72 million miles. Conjunction with the moon occurs on February 2. During the middle of the month it will rise about 4:00 P.M. for latitudes similar to that of the United States.

Jupiter will be an evening star of brightness about magnitude minus two in central Gemini, and it will rise about 2:00 P.M. during the middle of the month for northern latitudes. Its distance from the earth will be somewhat greater than 400 million miles, and its apparent motion among the stars will be retrograde. Conjunction with the moon will occur on February 28.

Saturn will be rather close to the sun in apparent position to be of much interest, conjunction having occurred early in January. The conjunction with Mercury, however, which will occur on February 1 will be of interest since, at that time, Mercury will be distant from Saturn only about a tenth the apparent diameter of the moon. Also on February 25 it will be in conjunction with Venus.

Uranus will be in central Pisces. During the middle of the month it will be on the meridian about 3:00 P.M., and its distance from the earth will be about 1900 million miles. Its apparent motion among the stars will be direct. On February 21 it will be in conjunction with the moon.

Neptune will be in south central Leo. It will be near the meridian at midnight during this period since opposition with the sun will occur on February 24. Its distance from the earth will be about 2700 million miles, and its apparent motion among the stars will be retrograde. On February 4 Neptune will be in conjunction with the moon.

Eros Ephemeris. — Definitive positions of Eros for the month of January, 1931, are given here as they are found in a paper by G. Witt, published in the

Astronomische Nachrichten, No. 5753.

1931 0h U.T.	α (1930.0) h m s	δ (1930.0) ° ′ ″	Log. Δ	Log. *r*	M
Jan. 0	10 21 52.81	+27 51 5.3	9.35355	0.05705	7.7
4	26 7.93	24 34 4.3	.33007	.05589	7.5
8	29 5.52	20 58 20.1	.30797	.05504	7.4
12	30 42.94	17 4 42.0	.28784	.05450	7.3
16	30 58.65	12 55 12.7	.27040	.05426	7.2
20	29 53.83	8 33 25.4	.25643	.05435	7.2
24	27 32.96	+ 4 4 36.0	.24663	.05475	7.1
28	24 3.68	— 0 24 28.9	.24151	.05545	7.1
32	19 36.26	— 4 46 10.1	9.24129	0.05647	7.1

This asteroid will be nearest the earth on January 30, when it will be about sixteen million miles distant.

OCCULTATIONS

VISIBLE AT WASHINGTON.
[From the *American Ephemeris*.]

Date 1931	Star	Mag.	IMMERSION Washington C.T. h m	IMMERSION *a* m	IMMERSION *b* m	IMMERSION Angle E from N °	EMERSION Washington C.T. h m	EMERSION *a* m	EMERSION *b* m	EMERSION Angle E from N °
Feb. 1	λ Cnc	5.9	23 33	..	..	192	23 46	..	..	210
8	621 B. Vir	6.4	4 20	—1.7	—0.6	120	5 38	—1.5	—1.3	313
10	31 B.Sco	5.4	4 57	—2.6	+1.4	73	5 56	—0.8	—1.5	341
24	104 B.Tau	5.5	23 26	—0.2	—0.6	68	0 21	+0.4	—1.3	275
27	406 B.Tau	5.6	2 26	—0.3	+0.1	42	2 56	+1.2	—2.1	329
27	49 Aur	5.1	17 6	—1.6	+0.4	108	18 17	—1.5	+1.8	244
27	54 Aur	5.8	19 29	—2.1	+1.7	63	20 40	—1.9	—2.0	306

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 or 300 miles of Washington. The procedure is as follows: Subtract the longitude of Washington (77°.1) from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude (38°.9) using *b*; apply the sum of the products, with its proper sign, to the Washington C.T., and obtain the predicted Washington Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to add 8.3 minutes to Washington Civil Time.

VISIBLE AT LICK OBSERVATORY AND VICINITY.

Date 1931	Star	Mag.	G.C.T. h m	*a* m	*b* m	P °
Feb. 2	Mars	—1.0	11 20	—1.0	+0.7	102
19 24	Piscium	6.1	22 46	—2.5	+0.9	78
23 19	Arietis	5.8	6 45	Grazing		9
25 104	B. Tauri	5.5	3 58	—1.8	+0.3	106
27 406	B. Tauri	5.6	7 19	—0.6	+0.3	113

The approximate times for observers within 300 miles of Omaha can be found by using the constants *a* and *b*, given in the table, according to the formula

$$\text{G.C.T.} = \text{Predicted G.C.T.} + a\Delta\lambda + b\Delta\phi,$$

$\Delta\lambda$ and $\Delta\phi$ in this case being obtained by using the longitude (96°.0) and latitude

(41°3) of Omaha, and subtracting these, respectively, from the longitude and latitude of the place.

For observers within 300 miles of Mount Hamilton, California, the same rule is followed using the longitude (121°7) and latitude (37°3) of Lick Observatory.

Only disappearances are given.

VISIBLE AT OMAHA AND VICINITY.

Date 1931	Star	Mag.	G.C.T. h m	*a* m	*b* m	P °
Feb. 2	Mars	—1.0	11 32	—0.4	+1.6	67
19	24 Piscium	6.1	23 50	Grazing		134
25	104 B. Tauri	5.5	4 23	—0.6	+1.1	100
27	406 B. Tauri	5.6	7 28	—0.4	+1.9	67
28	54 Aurigae	5.8	0 15	—1.0	+2.0	38

WM. CLETUS DOYLE, S.J.

Creighton University Observatory.

METEOR NOTES

By CHARLES P. OLIVIER.

In this month's article we will limit ourselves to observations made during November, 1930. Several interesting results can be set forth. The Leonids returned in unexpected strength on the night of November 16-17, which was at least a day later than we had reason to expect. A week of the worst weather, clouds, rain, and fog prevented any observing at Flower Observatory and generally throughout the eastern and northeastern United States. Fortunately, the central and southern areas had better luck, and already a few reports from ships have arrived. We are thus able to make the following statements.

Occasional Leonids were seen as early as the night of November 13-14 and as late as the night of November 21-22. The rate on November 14-15 and 15-16 was not higher than in recent years, but after midnight of November 16-17 the rate was very high at many stations, certainly going considerably over 100 per hour, despite moonlight, for an observer located in a favorable place. The shower was remarkable for the number of brilliant fireballs seen, some of which left trains remaining visible for many minutes. Also several observers report that they came in groups, with quiescent periods between.

This excellent display raises our hopes for finer showers in the next few years, but also warns us that we must have very many stations ready. So far, only one single member of the A.M.S. itself has reported that he observed on that night, most of us being completely cloud-bound. That we have any report at all for the maximum is due therefore to the casual observer, who had been reached by the wide publicity most kindly given us by both the public and scientific press. Also the maximum coming a day late doubtless deceived many observers. For the years 1931-35 inclusive we must be ready on all nights from November 13 to 18 at least, so as not to be caught napping by further unexpected shifts of the date of maximum. It is still possible that some belated report may arrive, and there has not been time as yet to hear fom our members in the Southern Hemisphere. As several of our active members worked on a number of nights in November, it can only be put down to hard luck that they had to miss the finest display since 1901, if not earlier.

Observer and Station	Time Belt	1930 Nov.	Began	Ended	Ttl.	Mtrs.	F.	R.	Cor.R.	Remarks
Miss M. L. Armor, Sarasota, Florida	5	14	15:	16:	60	50	0.8			8 observers, Science Class.
A. A. Hughes, Hardin, Missouri	6	14	15:30	16:03	33	2	0.7			Looking straight at moon.
Miss Crystal Wheeler, Hutchinson, Kansas	6	14	12:00	16:00	240	32	0.8	8	10	
Thomas Jordan, Findlay College, Ohio	5	14	12:05	13:35	90	26	0.8			2 observers.
			13:35	14:30	55	3	0.8	3	4	1 observer.
Miss V. E. Ashdown, Mosongo Valley, Calif.	8	14	11:40	17:00	320	21	0.7	4	6	
Y. K. Roberts, 70^{m} S. Findlay, Ohio	5	15	12:30	17:45	30	0	0.8	0	0	
Miss F. A. Dennis, Springer, New Mexico	7	15	9:45	15:20	?	3	0.5			
Miss Maureia Nuez, Lake Arthur, La.	6	15	14:		30	11	0.9	22	24	
		16	13:45	15:45	120	69		34		Leonids; left trails.
L. E. Selby, Jacksonville, Florida	5	15	11:30	11:50	20	4	0.7	12	17	
H. T. Roe, Cuero, Texas	6	15	10:30	12:	90	..	0.8	6		
W. A. Shields, Huntingdon, Pennsylvania	5	16			20-25					"about 17:15." Two watching.
H. L. Disheroon, Hot Springs, Arkansas	6	16	17:		15-20	40				"mostly eastward."
Judge V. S. Ledgerwood, Lake Catharine, Ark.	6	16	16:30	17:30	60	250-300				Estimation only; 3 observers.
Leon Carter, Mayfield, Kentucky	6	16	17:20	17:50	30	12		24		In north; apparently from window.
Miss Harriet Anderson, Grand Island, Neb.	6	16	17:55		20	25		75		From west window; 2 seen later.
Miss Phyllis Schaefer, Milwaukee, Wisconsin	6	16	16:35	17:53	78	20		15		In South and West.
S. F. Maxwell, Chicago, Illinois	6	16	16:	17:30	90			163		"One every 22 seconds."
Miss B. F. Mumma, Waynesboro, Pa.	5	16	18:	18:10	10	8	0.8	48	60	Only clear interval.
R. W. Carpenter, Isle Pines, Cuba	5	16	17:	18:	60	40	0.8	40	50	
T. H. Bockhoff, E. of Florida Coast	5	16	15:30	18:		50	0.8			
Ed. G. Howe, Chicago, Illinois	6	16	14:30	15:15	45	31	0.6	40	67	
A. J. Adams, Pine Bluff, Arkansas	6	16	14:	18:		75-100				Estimate; came at intervals in bunches.
Dr. Geo. A. Stock, Outwood, Kentucky	6	16	16:30			40-50	0.8			2 observers.
J. P. North, Wausau, Wisconsin	6	16	16:45	17:45	60	29	0.8	29	36	Apparently from window (?).
Alois Huser, Vesper, Wisconsin	6	16	14:30	16:	90	36	0.8	24	30	To south, moving E to W.
G. Besihoff, Palm City, Cuba	5	16	17:		10-15	18		>72		
Miss Mary Jones, Paducah, Kentucky	6	16	17:	17:30	30	40-50		>80		Came in groups; intervals with none.

Observer and Station	Time Belt	1930 Nov.	Began	Ended	Ttl.	Mtrs.	F.	R.	Cor.R.	Remarks
Chas. Kiesaw, Kiowa, Iowa	6	16	17:20	18:20	60			22		
E. W. Bluvett, Kiowa, Iowa	6	16	17:20	18:20	60			27		
Harry F. Ryan, S.S. West Maximus		16	14:00	14:30	30	30±		60		Long. 38° W, Lat. 45° N.
Cyril Bauer, Sycamore, Illinois	6	16	17:	17:45	45	50		67		
Miss B. G. Williams, Cuba, N. Y.	5	16	12:	15:	180	12	0.4			High School Club observing.
Miss J. E. Harding, Oberlin, Ohio		15	14:00	17:00	180	24	0.7			Equivalent 1½ observers.
		16	15:45	18:10	145	24	0.6			" 3 observers; 16 seen first hour.
Mrs. J. F. Kemp, Seymour, Texas	6	..				37				High School Class, Oct. 31-Nov. 18.
		16	16:	18:	120	37		18		One observer.
E. H. Clarke, Hiram, Ohio	5	14	17:00	17:30	30	15	0.8			4 obs., different quadrants, 12 Leonids.
	5	17	16:20	17:00	40	16				14 Leonids.
Miss Z. Muller, Iola, Kansas	6	10	6	10		6				
		11	8	12		5				
		12	7			5				
		13	8	11	180	20				General Science Class: number of observers not given.
		14	9	12		16				
		15	7	16		28				
		16				8				
		16	16	18	120	40				
Clyde Vincent, Alden, Kansas	6	16	11	13:20	140	5		2		All apparently Leonids.
			17	dawn		4				All apparently Leonids.
Samuel Bonestead, Glen Eyre, Pennsylvania	6	17	8:30	9:30	60	12	0.9	12	13	Only clear interval.
A. K. Showalter, LaCrosse, Wisconsin	6	16	14:30	15:10	40	19	0.8	28	35	
			15:15	17:08	33	13	0.5			1 intermittent } Mostly Leonids.
			17:12	17:30	18	29	0.8	97	121	
Franklin March, Frederick, Maryland	5	16	15:30	15:55	25	6	0.5	15	30	4 Leonids.
C. P. Schaefer, Nashville, Tennessee	6	18	8:35	10:00	85	10	1.0	7.0	7.0	
		26	9:00	11:00	120	8	1.0	4.0	4.0	
O. E. Monnig, Ft. Worth, Texas	6	14	14:18	15:55	97	15	0.5	9.2	18.4	8 Leonids.
	6	17	15:07	17:50	163	44	0.8	16.2	20.2	22 Leonids.
B. Sanders, Ft. Worth, Texas	6	16	17:	18:		25-30		>30		Bright Leonids; intermittent watch.

Observer and Station	Time Belt	1930 Nov.	Began	Ended	Ttl. Mtrs.	F.	R.	Cor.R.	Remarks
Lincoln LaPaz, New Albany, Ohio	5	14	9:00	15:00	360 66	0.6	11.0	18.3	11 Leonids plotted.
		15	15:00	17:20	140 14	0.6	6.0	10.0	8 Leonids plotted.
		17	7:00	9:00	120 9	1.0	4.5	4.5	
		19	7:00	8:07	67 0	1.0	0.	0.	
		19	17:35	18:22	47 7	1.0	9.0	9.0	3 Leonids.
Dan. F. Waugh, Tokyo, Japan	9E	14	10:12	12:12	120 6	0.8	3.0	3.8	No Leonid.
		18	12:25	14:25	120 15	1.0	7.5	7.5	3 Leonids.
		21	11:22	13:52	150 16	1.0	6.4	6.4	2 possible Leonids.
		24	11:43	13:43	120 6	1.0	3.0	3.0	
		27	11:52	13:32	100 10	0.8	6.0	7.5	
		29	13:22	15:02	100 5	0.9	3.0	3.3	
K. E. Gell, Garnett Mt., New York	5	14	10:00	12:30	90		4-6		
			12:30	13:51	81 14	1.0	10.4	10.4	7 Leonids.
			13:51	15:22	91 0		0.		Sudden drop in rate!
J. E. McKee, Mt. Vernon, Ohio		19	7:30	9:30	120 4	1.0	2.0	2.0	
F. K. Smith, Glenolden, Pennsylvania	5	19	9:00	10:00	60 2	0.9	2.0	2.2	
		20	8:05	9:05	60 3	0.9	3.0	3.3	
		23	8:15	9:15	60 3	1.0	3.0	3.0	
T. K. Tomkins, N. Glenside, Pa.	5	23	11:13	13:40	147 9	1.0	3.7	3.7	
		28	11:07	13:07	120 10	1.0	5.0	5.0	
G. W. Ridley, Alameda, California	8	13	13:00	15:05	125 16	0.8	7.7	9.6	2 Leonids.
		18	13:12	15:12	120 26	1.0	13.0	13.0	6 Leonids.
		19	13:02	15:02	120 12	1.0	6.0	6.0	2 Leonids.
		20	13:03	16:03	180 35	1.0	11.7	11.7	2 Leonids.
		21	13:05	15:05	120 23	1.0	11.5	11.5	4 possible Leonids.
		22	6:45	8:00	75 8	1.0	6.4	6.4	
			10:40	12:00	80 11	1.0	8.2	8.2	
		23	8:14	10:44	150 14	1.0	5.6	5.6	
		24	13:00	15:00	120 23	1.0	11.5	11.5	
		25	13:00	13:30	30 3	0.8	6.0	7.5	

The most vivid descriptions of the shower come from several ships, and considerably abridged accounts will now be given in the words of the officers themselves. These are received through the active coöperation of the Hydrographic Bureau, U.S.N., and the U. S. Weather Bureau, the writer constantly receiving interesting reports from ships at sea on meteoric phenomena.

(1) Second Officer Amm, *Am. S. S. Liebre,* lat. 24° 30′ N, long. 81° 27′ W; "Meteors were plentiful during the night and as many as six were observed at one time . . . One . . . meteor left a very luminous trail which, 3 minutes after the body's appearance, formed an inverted U, which drew towards Rigel, and was still visible, 7 minutes later, 5° below that star."

(2) Third Officer Martinoz, *Am. S. S. Ohioan,* between Navassa Island and Haiti, between 12:30 and 3:30 A.M. (75°) . . . "Countless meteors were observed all over the eastern heavens but the greatest number appeared in the vicinity of . . . Leo. They were of every degree of size and brightness, some of them two or three times the size of Jupiter. . . . At times the earth and the whole sky was illuminated. . . . The most remarkable meteor of the shower appeared at 2:50 A.M. in the Milky Way just above the Southern Cross and traveled very slowly and horizontally to the north. The coast of Haiti, 20 miles away, was visible as in daylight. The body burst near the Great Bear and disappeared, then an explosion was heard. This phenomenon appeared larger than the sun and was visible nearly a minute."

(3) Second Officer G. A. Eklund, *Am. S. S. C. A. Canfield,* while steaming from lat. 23° 26′ N, long. 91° 25′ W to lat. 23° 30′ N, long. 90° 52′ W, 6:03 to 9:10 G.M.T. (Civil) . . . "a great many meteors were observed . . . Some of the meteors appeared to travel as much as 40°, but the majority . . . at least 5°. At one time during one minute's observation . . . 27 meteors were counted . . . During this beautiful display, with an exceptionally clear sky, about 150 meteors were bursting and zig-zagging across the heavens, leaving trails of fire. In some instances they lasted as much as 2 minutes before the sparks disappeared to the naked eye, although with glasses the remains of their trails could be seen for 5 minutes. An interesting feature, evidently attributable to this phenomenal display, was what apparently seemed to be large 'gas or mist bags' appearing around some of the larger stars and planets."

(4) Officer I. Lystad, *Am. S. S. Dorothy Luckenbach,* lat. 26° 30′ N, long. 114° 10′ W, at 1:45 A.M., L.A.T. "An unusually bright meteor shot was observed . . . leaving a bright trail of light . . . for over half an hour. This was followed by several . . . over the same area during next 10 minutes. At 2:30 the trail of the first one could be seen as a long faint cloud."

In the above table, for the later parts of the nights when the Leonids were visible, due to moonlight the highest factor that could be given was 0.8, even when the sky was reported very clear. The standard time belt is given in column 2 when reported by the observer or certainly known by the writer. Nearly all the rest are in the 5 or 6 hour belt.

Flower Observatory, Upper Darby, Pennsylvania, 1930 December 18.

A Supposed Death from a Meteorite

In May, 1930, Mr. Thomas M. Galey, of Independence, Kansas, forwarded the following report of a supposed death in Nicaragua from a meteorite. The young man giving the report, Mr. Lyons, was in Nicaragua as a soldier in 1922 and heard the story at that time.

"General Pablo Castilliano, a rebel who was revolting against the Nicaraguan government was killed by a meteor in 1906 in a jungle camp near Puerto Cabezas, Nicaragua, while sitting in his tent at night.

"The natives immediately quit the revolt, claiming that Castilliano was an emissary of 'El diablo,' and was removed by an act of God.

"While in the ill-starred Nicaraguan revolt of 1922, I learned of the incident. The natives were still superstitious of meteors, and we had many desertions following a meteor shower in June, 1922. MELVILLE S. LYONS."

Independence, Kansas, May 5, 1930.

On the receipt of this report we wrote to Mr. Tyler Dennet, Historical Adviser in the Department of State. Mr. Dennet forwarded us the result of his investigation on September 9, 1930, enclosing the following letter from an American Consul.

"I have the honor to acknowledge receipt of the Department's Instruction of July 11, 1930, enclosing a copy of a letter dated June 14, 1930, from C. C. Wylie of the University of Iowa, Iowa City, requesting an investigation of the report that General Pablo Castilliano, a rebel against the Nicaraguan government was killed in a jungle camp near Puerto Cabezas, Nicaragua, in 1906 by a meteor.

"After a careful investigation it has been impossible for this consulate to establish the correctness of the above mentioned report. No record of such an occurrence has been found in consular or local municipal official records, and responsible individuals of Bluefields failed to remember such an event.

"General Juan J. Estrada, Ex-President of Nicaragua, was Governor of this Department during 1906, and he states that while Puerto Cabezas did not exist at that time, police authorities were located at the mouth of the Wawa river and in the village of Yulu, but none of their reports indicate either a revolt or the death of General Pablo Castilliano by a meteor.

"The Right Reverend Guido Grossmann who has been in eastern Nicaragua for about thirty years and who now resides in Puerto Cabezas, stated that he was a Moravian Missionary at Sandy Bay (near Puerto Cabezas) during 1906 and that he had never heard of such an incident. He added that a number of years ago when he was near the bank of the Waspuc River, a meteor fell about fifteen miles from his camp.

"At Puerto Cabezas, the Collector of Customs, Mr. T. G. Downing, made inquiries of many of the older residents of that section of Nicaragua, but none remembered the incident. Respectfully yours,

SAMUEL J. FLETCHER, American Consul."

A letter was also dispatched to the American Minister at Nicaragua, Mr. Mathew E. Hanna, and under date of August 18, 1930, Mr. Hanna replied. "The Legation so far has been unable to verify the report. Should any information concerning the alleged incident be received later I shall be pleased to communicate it to you."

It appears then that this story must be classed with numerous other reports of death by a meteorite which may be founded on fact, but which cannot be definitely verified. The earliest of these reports is no doubt the story in Joshua of the Lord casting down great stones from heaven on the enemies of Israel so that they that perished from the stones were more than they that perished by the swords of the children of Israel. Many believe that this refers to a shower of meteorites although the translators refer to these stones as hailstones, and we know that hailstones occasionally kill farm animals. Several accounts of supposed

deaths a few hundred years ago are included in some of the older books on meteors. For example, we are told that on September 14, 1511, there was an almost total darkening of the heavens at Crema. The midnight gloom was accompanied by "unheard-of thunders" and "awful lightnings." It is said that about twelve hundred stones fell, the display lasting two hours, and also that a monk was killed by one of the stones. Other accounts are that on March 30, 1650, a Franciscan monk was killed at Milan by the fall of a meteoric stone, and that in 1674 two Swedish sailors were killed on shipboard by the fall of a meteorite. The evidence for these reports is, however, so poor that modern writers class all as "not proven." Similar accounts appear in the newspapers from time to time at present. For instance, two or three years ago there was a report of a guest at a wedding being killed in a carriage by a meteor, in one of the Slavic states in Europe. POPULAR ASTRONOMY recently (March, 1928) printed a story of a child being struck and burned by a meteoric stone in Japan. None have, however, been definitely authenticated and the more recent report of the death in Nicaragua must evidently be placed in the same class.

Meteoric falls have in recent years been recovered at about the rate of one every sixteen months in the United States. The land area is approximately 3,000,000 square miles and the population is about 120,000,000. If we allow ten square feet for each person, this will be more than is necessary when a person is standing erect but at night, or when reclining, the ten square feet is hardly enough. The situation is further complicated by the fact that we do not have a uniform distribution of population. It is possible that a meteorite falling through a high apartment building might strike two or three indivduals. Further, if a person is in a well constructed building he is so well protected that only an extremely large meteorite could come through and injure him. However, assuming that ten square feet is approximately the area within which a meteorite can strike and injure a person, we find that human beings occupy about 1,200,000,000 square feet or about forty-three square miles out of the total area of the United States. Assuming uniform distribution it would take seventy thousand meteoric falls to put one in the area occupied by human beings. At the observed rate, one every sixteen months, this would mean 93,000 years. The observed rate is too small because there is no doubt that many meteorites are not recovered, and occasionally two or more meteorites of appreciable size are recovered at the same meteoric fall. If the observed rate is multiplied by ten for these reasons, we find that one should expect injury to a human being from a meteorite in the United States about once in 9,300 years. For the entire civilized world, there should have been very few instances of injury to human beings since the beginning of history. It is not surprising that there are no definite authentic records.

The result, that a meteorite can be expected in an area of 43 square miles about once in 9,300 years, together with the fact that the average meteorite oxidizes rapidly when exposed to the elements, has a bearing on another problem. Meteorites have never been found preserved in terrestrial rocks from the earlier geological periods, and this figure shows that such prehistoric meteorites should be excessively rare.

C. C. WYLIE.

University of Iowa, December 13, 1930.

Fireballs Observed. On the evening of October 21, while observing variable stars with a 3-inch refractor, I happened to glance up at the sky in the direction of the constellation Cetus. I saw a fireball, whose magnitude I should

estimate as —7. It was orange, about the same color as Arcturus, and lasted about 5 seconds, it began near Beta Arietis and ended near 30 Piscium. The diameter was about 8′. The fireball left a yellow-white train which remained visible about 15 seconds after the meteor had disappeared. The time was about 8:10 P.M., C.S.T.

The second fireball was seen at 9:00 P.M. on October 29. I was again observing long period variables. A fireball of magnitude —6 appeared due west of Beta Ceti and described a track, 5° in length straight down, in the direction of the southern horizon. It lasted only one or two seconds, and left a white train, which remained visible for perhaps half a minute afterwards.

The third and most remarkable fireball was seen at 9:10 P.M., C.S.T., on November 8. This had a magnitude of —8 or —8.5, as far as the observer was able to judge (an accurate estimate of brightness being difficult owing to the bright moonlight at the time). This fireball was blue-white in color, and had a central nucleus about 6′ in diameter, which was surrounded by a sort of nebulosity extending out on all sides to a distance of about 5′ from the edges of the nucleus. It lasted about 2 seconds beginning near Alpha Cassiopiae and ending near Beta Andromedae. It ended by exploding, and left a reddish train, which was visible about 15 seconds after the meteor disappeared.

NOAH W. MCLEOD.

Christine, North Dakota, November 9, 1930.

An Afternoon Meteor.—Wednesday afternoon I saw a most unusual sight, a flaming meteor in broad daylight, about 4:45 P.M. It went from west to east to the north of me, and seemed as near as a mile away. * * * It went straight, and very fast, and was very bright and beautiful. Probably only a few persons saw it. It disappeared in the air so must have been burned out there.—PERCIVAL B. COBB, Massapequa, N. Y., *The New York Times*, Sunday, November 23, 1930.

VARIABLE STARS

Monthly Report of the American Association of Variable Star Observers for November, 1930

A digest of the accompanying report may prove of interest to our members. Of the 2238 observations listed, 1047, or 47 per cent, were contributed by our foreign observers, representing five different countries. Sixty-four per cent of the whole were made by seven observers, or eighty per cent by eleven members. This does not imply that the remaining twenty per cent distributed among twenty-seven observers are less valuable, for indeed many of them fill gaps on curves which would otherwise prove a serious detriment to our knowledge of these stars. This applies in particular to the irregular variables and those of the R Coronae Borealis and SS Cygni types.

Mount Holyoke College is here represented in the observations made by Misses Gooch and Ross, students working under the guidance of Mrs. Hogg. We are pleased to include, after a long silence, the observations of Mr. Skaggs of Oakland, California, who also communicates a list by Mr. F. B. Wright of Berkeley, California.

Variable Star Observations Received During November, 1930.

Sept. 0 = J.D. 2426220; Oct. 0 = J.D. 2426250; Nov. 0 = J.D. 2426281.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Scl	**R And**	**V And**	**S Cas**	**U Per**	**o Cet**
000339	001838	004435	*011272*	015254	*021403*
233[13.3 En	274 9.6 Fd	262 9.2 B	247 11.5 Jo	268 8.7 BL	262 7.3 Tf
238[13.3 En	275 9.3 Ma	**RR And**	261 11.6 Jo	271 8.7 BL	263 7.7 Jo
S Scl	275 9.7 Ah	004533	262 11.8 B	*272* 8.5 B	263 7.8 Ah
001032	276 9.3 Fd	262[13.8 B	270 11.7 Jo	272 8.4 Jo	267 7.9 Ah
231 8.1 Ht	276 9.2 Gy	264[13.3 Mg	U Psc	276 8.8 Mc	268 8.3 Wd
233 8.3 En	276 9.4 Wd	**RV Cas**	011712	276 8.5 BL	268 7.8 BL
236 7.6 Ht	278 9.2 Fd	004746a	264 11.4 Mg	278 8.2 Pt	269 7.8 Jo
237 7.9 En	279 9.0 Me	263[14.2 B	275 11.5 Fd	278 8.5 L	269 8.0 Ah
239 7.5 Kd	280 9.1 Fd	— Cas	276 11.4 Fd	282 8.5 BL	270 7.9 Ah
242 7.3 Ht	290 8.7 Fd	004746b	276 11.8 Pt	284 8.5 Al	271 8.5 Tf
248 6.5 En	290 8.8 Wd	274 10.6 Pt	277 11.3 L	288 8.4 BL	271 8.0 BL
249 6.9 Ht	291 8.4 Gy	W Cas	278 11.5 Fd	289 8.6 BL	272 7.8 Jo
X And	292 8.4 Me	004958a	**RZ Per**	290 8.2 Me	273 8.2 Tf
001046	S Tuc	247 9.6 Jo	012350	S Ari	273 7.9 Ah
261 12.8 Br	*001862*	251 9.7 Jo	272 9.7 B	015912	273 7.8 L
T Cet	232 11.3 Ht	261 9.5 Jo	*272* 9.4 L	273 14.5 L	275 8.2 Ma
001620	233 11.0 En	262 9.7 B	R Psc	275[14.0 B	276 8.6 Gy
192 6.6 Kd	237 10.8 En	263 9.3 Jo	012502	R Ari	276 8.2 BL
219 6.6 Kd	237 10.8 Ht	268 9.9 BL	263 10.3 Ah	021024	276 8.4 Wd
239 6.7 Kd	245 10.9 Ht	270 9.4 Jo	265 10.2 Ah	269[10.7 Fd	276 7.9 Jo
262 6.3 Tf	S Cet	271 9.8 BL	267 10.0 Ah	273 12.0 L	278 8.0 Pt
271 5.9 Tf	*001909*	271 10.7 Bw	269 9.9 Ah	275 12.7 Ma	281 8.4 Tf
272 6.6 L	247 10.4 Jo	272 9.2 Jo	270 9.8 Ah	275 12.3 B	282 8.4 BL
273 5.8 Tf	251 10.0 Jo	274 9.4 Pt	273 9.8 Ah	278 12.6 Pt	288 8.6 BL
277 5.8 Tf	262 10.0 Tf	276 9.8 BL	276 9.8 Pt	280[12.3 Fd	290 8.6 Wd
T And	262 10.1 Jo	278 9.9 BL	294 9.5 Mc	290 10.6 Fd	291 8.6 Gy
001726	273 9.9 Tf	280 9.8 Fd	**RU And**	**W And**	292 8.1 Me
266 13.6 B	274 9.3 Pt	282 9.7 BL	013238	021143a	**S Per**
274 13.8 Pt	276 9.7 Sf	288 9.7 BL	263 12.9 B	272 12.0 B	021558
T Cas	277 9.9 L	289 9.8 BL	264 12.7 Mg	278 12.0 Pt	247 8.6 Jo
001755	291 8.3 Sf	U Tuc	272 12.1 L	**T Per**	251 8.6 Jo
247 9.0 Jo	292 8.2 Fe	*005475*	275 12.0 Ma	021258	256 8.9 Sz
251 9.0 Jo	T Scl	232 11.4 Ht	278 12.1 Pt	247 8.7 Jo	262 8.5 Jo
261 9.0 Jo	*002438a*	237 11.8 Ht	280 12.5 Fd	251 8.5 Jo	263 9.4 Ah
262 8.8 B	233 9.8 En	237 11.9 En	**Y And**	262 8.2 Jo	267 9.4 Ah
263 9.2 Ah	238 9.8 En	245 12.3 Ht	013338	263 8.7 Ah	268 9.3 BL
263 8.9 Jo	**T Phe**	**Z Cet**	264 11.6 Mg	267 8.7 Ah	269 9.6 Fd
267 9.1 Ah	*002546*	*010102*	*272* 11.4 L	268 8.7 BL	270 8.3 Jo
268 9.0 Ah	233[13.0 En	266 11.6 L	275 11.3 B	270 8.3 Jo	271 9.5 BL
269 8.8 Ah	237[13.0 Ht	275 11.3 B	278 11.2 Pt	271 8.7 BL	272 9.0 Sz
270 8.7 Jo	245[13.0 Ht	276 11.0 Pt	280 11.0 Fd	274 8.6 Me	272 9.2 B
272 8.6 Jo	**W Scl**	292 10.0 Fe	**X Cas**	275 8.7 Ah	274 9.0 Me
273 9.0 Ah	*002833*	**U And**	014958	276 8.4 BL	275 9.4 Ah
274 9.8 Pt	238[12.8 En	010940	247 11.5 Jo	276 8.3 Jo	276 8.4 Jo
277 9.0 L	**Y Cep**	*264*[13.0 Mg	251 10.5 Jo	276 8.8 Fd	276 9.3 BL
291 8.6 Mc	003179	275[13.5 B	261 10.3 Jo	278 8.4 Pt	276 9.4 Fd
R And	272 13.4 L	272[13.5 L	263 10.4 Jo	282 8.6 BL	278 9.0 Pt
001838	**U Cas**	280[11.8 Fd	270 10.3 Jo	288 8.4 BL	282 9.2 BL
263 10.2 Ah	004047a	**UZ And**	271 11.0 Bn	289 8.3 BL	284 8.5 Al
266 10.0 Ah	272[13.3 L	011041	272 10.5 B	**Z Cep**	288 9.4 BL
266 9.4 Wd	275 14.1 B	275 14.1 B	275 11.2 Bn	021281	289 9.5 BL
266 9.8 B	280[12.2 Fd	275 14.0 Ma	276 10.3 Jo	273 10.9 L	**R Cet**
267 10.0 Ah	**RW And**	**S Psc**	278 11.6 Pt	278 11.1 Pt	*022000*
268 9.9 Ah	004132	011208	292 11.5 Bn	**o Cet**	275 11.4 L
269 9.9 Ah	272 10.7 L	275 13.4 B	**U Per**	*021403*	292[11.4 Fe
273 9.7 Ah	*274* 10.5 Pt	277 13.7 L	015254	192 4.9 Kd	
274 9.5 Pt	281 10.1 Tf		263 8.6 Jo	250 7.0 Jo	

Variable Star Observations Received During November, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RR Per	W Per	T For	R Pic	S Aur	SU Tau
022150	024356	*032528*	*044349*	052034	054319
271 9.0 Gc	272 9.0 Jo	277 8.9 L	242 9.7 Ht	291 10.2 Mc	250 15.2 L
272 9.6 B	272 9.3 B	U Eri	249 9.7 Ht	294 10.1 Mc	257[13.3 L
275 9.8 L	276 9.0 Jo	*034625*	V Tau	298 10.0 Mc	264[11.5 Pt
278 9.5 Pt	276 9.6 Mc	277[13.0 L	044617	W Aur	266[13.3 L
U Cet	278 8.8 Pt	R Tau	278 9.5 Pt	052036	268[12.4 Pt
022813	278 9.0 Fd	042209	R Eri	274 13.0 Pt	269[11.5 Pt
268 8.9 BL	279 9.2 Me	275 10.8 Ma	*045016*	275 13.3 L	271[11.5 Pt
271 9.1 BL	283 9.5 Bw	278 11.5 Pt	274 5.7 Fd	280[12.1 Fd	274[13.5 Pt
276 9.3 BL	291 10.2 Mc	291 12.0 Bg	R Ori	S Ori	275[14.6 L
276 9.5 Gy	292 10.2 Mc	W Tau	045307	*052404*	276 15.2 L
278 9.6 Pt	R Hor	042215	275 10.5 L	274 9.6 Pt	277[15.0 L
282 9.4 BL	*025050*	247 11.0 Jo	R Lep	T Ori	278[13.5 Pt
288 9.7 BL	236 10.9 Ht	261 11.5 Jo	*045514*	*053005a*	280[13.5 Pt
RR Cep	237 11.2 En	269 12.0 Jo	247 7.1 Jo	247 9.5 Jo	Z Tau
022980	242 11.5 Ht	273 11.6 L	250 7.0 Jo	250 9.6 Jo	054615a
273 13.5 L	249 12.0 Ht	274 11.0 Sg	269 7.0 Jo	250 10.1 L	275 13.2 L
R Tri	T Hor	278 11.5 Pt	271 6.9 Tf	257 10.9 L	α Ori
023133	*025751*	282 11.4 Bw	273 6.6 Tf	266 10.3 L	054907
247 6.7 Jo	236 12.9 Ht	S Tau	274 7.1 Fd	268 10.5 Pt	266 0.3 L
251 6.6 Jo	242 12.7 Ht	042309	274 6.8 Pt	270 10.9 Gc	276 0.2 L
261 6.5 Jo	249 12.4 Ht	275 12.2 Ma	275 7.1 L	272 10.3 L	298 0.4 Mc
262 6.1 Tf	U Ari	278 12.5 Pt	275 6.6 Ma	274 10.5 Pt	U Ori
263 6.6 Ah	030514	291[12.8 Bg	280 6.8 Tf	274 10.0 Fd	054920a
266 6.7 Ah	273 14.5 L	T Cam	281 6.3 Tf	275 10.2 L	247 8.9 Jo
266 6.1 Wd	X Cet	043065	V Ori	275 10.5 Pt	250 8.8 Jo
268 6.7 Ah	*031401*	251 8.5 Jo	050003	276 10.2 L	261 8.6 Jo
269 6.8 Ah	273 9.0 L	261 8.7 Jo	247 9.5 Jo	277 10.2 L	265 7.6 Ah
270 6.8 Ah	275 9.4 Fd	263 8.8 Jo	250 9.6 Jo	278 10.8 Pt	266 7.6 Ah
270 6.1 Tf	275 8.8 B	270 8.9 Jo	267 9.6 Ah	280 10.9 Pt	267 7.4 Ah
270 6.5 Jo	278 8.5 Pt	272 8.9 Jo	269 9.4 Ah	280 10.1 L	269 7.4 Ah
270 6.9 Wd	Y Per	273 8.8 L	274 9.6 Pt	280 10.0 Fd	270 7.2 Ah
271 6.3 Tf	032043	278 9.4 Pt	275 9.5 L	AN Ori	273 7.0 Ah
271 5.9 Sf	247 8.7 Jo	RX Tau	280 9.2 Fd	*053005t*	274 6.8 Pt
272 6.4 Jo	251 8.7 Jo	043208	T Lep	257 11.5 L	274 7.2 Fd
273 6.4 Tf	262 8.6 Jo	270 11.6 Gc	*050022*	280 11.6 L	275 7.2 Fd
273 6.7 Ah	263 9.2 Ah	275 11.4 L	274 10.5 Pt	S Cam	276 6.8 Wd
275 6.2 Ma	267 9.0 Ah	278 11.2 Pt	S Pic	053068	280 6.6 Fd
276 6.8 Gy	268 9.3 BL	284 11.7 Gc	*050848*	278 9.0 Pt	V Cam
276 6.3 Fd	269 9.2 Ah	R Ret	249[11.4 Ht	RR Tau	054974
276 6.9 Wd	270 8.4 Jo	*043263*	R Aur	053326	276 13.5 L
276 6.4 Jo	271 9.0 BL	236[12.3 Ht	050953	250 10.7 L	Z Aur
276 6.5 Pt	273 9.2 Ah	242[12.3 Ht	274 9.5 Pt	257 11.2 L	055353
277 6.4 Tf	273 8.8 GD	249 12.5 Ht	276 9.5 Wd	266 10.7 L	262 9.9 Pt
280 6.5 Tf	276 8.5 Jo	X Cam	292 10.0 Me	272 10.7 L	263 9.8 Pt
281 6.6 Tf	276 8.5 BL	043274	T Pic	275 10.8 L	263 8.6 Ah
284 6.7 Wd	278 8.5 Pt	250 8.5 L	*051247*	276 10.9 L	264 9.9 Pt
290 7.0 Wd	280 8.3 Me	273 8.8 L	242 8.0 Ht	277 10.9 L	267 8.8 Ah
290 7.4 Fd	282 8.8 BL	278 8.6 Pt	249 8.4 Ht	280 10.9 L	268 9.6 Pt
291 7.2 Gy	288 8.5 BL	R Dor	Nov Tau	RU Aur	269 9.7 Pt
T Ari	291 9.2 Mc	*043562*	051316	053337	269 8.8 Ah
024217	R Per	236 5.2 Ht	275 14.3 L	270 10.5 Gc	270 9.9 Pt
292 8.4 Me	032335	242 5.2 Ht	T Col	274 8.0 Pt	271 9.9 Pt
W Per	272 10.6 B	249 5.5 Ht	*051533*	284 11.6 Gc	273 8.9 Ah
024356	273 10.8 Mg	R Cae	249 11.9 Ht	U Aur	274 9.7 Pt
247 9.7 Jo	273 11.0 L	*043738*	S Aur	053531	275 9.7 Pt
251 9.5 Jo	275 11.5 Fd	249 8.6 Ht	052034	274 13.4 Pt	275 10.6 Fd
262 9.2 Jo	275 11.0 Ma		274 9.3 Pt	275 13.9 L	276 9.9 Mc
270 9.0 Jo	278 11.6 Pt		276 10.3 Mc		276 9.9 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z AUR	R LYN	R CNC	R LEO	R UMA	T UMA
055353	065355	081112	094211	103769	123160
278 9.9 Pt	280 8.6 L	274 10.9 Fd	273 9.2 Tf	273 7.7 Ah	187 9.4 HS
280 9.7 Pt	V CMI	V CNC	274 9.0 Pt	274 7.4 Pt	196 9.8 HS
291 9.7 Mc	070109	081617	274 10.2 Fd	274 7.1 Fd	204 10.6 Wr
294 9.8 Mc	274 9.6 Pt	274 10.8 Pt	279 9.0 Me	276 7.4 Wd	274[12.0 Pt
R OCT	277 9.5 L	274 11.0 Fd	280 9.2 Tf	276 7.7 Gy	280[12.0 Fd
055686	280 9.3 Fd	277 10.4 L	280 9.7 Fd	280 7.6 Tf	RS UMA
232 10.1 Ht	R GEM	RT HYA	281 9.3 Tf	290 7.9 Wd	123459
237 9.7 Ht	070122a	*082405*	Y HYA	290 8.7 Mc	269 12.4 Bn
237 9.9 En	274 10.6 Pt	274 7.6 Pt	*094622*	291 8.1 Gy	274 12.1 Bn
244 10.0 Ht	276 10.9 Wd	R CHA	274 6.8 Pt	294 8.8 Mc	274 11.6 Fd
249 10.2 Ht	280 10.0 Fd	*082476*	Z VEL	298 9.0 Mc	274 11.7 Pt
X AUR	Z GEM	238 12.1 Bl	*094953*	V HYA	280 10.7 Fd
060450	070122b	U CNC	238[12.1 Bl	*104620*	287 9.8 Bn
274 9.7 Pt	274 12.5 Pt	083019	V LEO	266 6.6 L	290 9.9 Wd
275 10.0 Fd	280[11.6 Fd	277 9.8 L	095421	W LEO	291 9.5 Gy
277 10.5 L	TW GEM	291 9.2 Bw	274 9.0 Pt	104814	292 9.4 Bn
V AUR	070122c	X UMA	RV CAR	266 11.9 L	297 9.2 Bn
061647	274 8.6 Pt	083350	*095563*	274 12.0 Pt	S UMA
277 11.5 L	R CMI	274 10.0 Pt	238[13.1 Bl	S LEO	123961
V MON	070310	S HYA	S CAR	110506	244 9.5 Wr
061702	274 9.0 Pt	084803	*100661*	274 11.8 Pt	248 8.9 Wr
274 9.8 Pt	277 9.0 L	274 8.2 Pt	238 6.2 Bl	280 12.5 L	247 9.4 Jo
AG AUR	V GEM	274 8.0 Fd	Z CAR	RY CAR	251 9.5 Jo
062047	071713	T HYA	*101058a*	*111561*	260 8.7 Ah
257 8.8 L	274 13.1 Pt	*085008*	238[12.6 Bl	231[12.1 En	261 8.8 Jo
277 9.5 L	277 13.9 L	274[11.2 Fd	W VEL	238[13.1 Bl	263 8.5 Wr
R MON	S CMI	277 11.5 L	*101153*	RS CEN	263 8.5 Ah
063308	072708	T CNC	238[12.0 Bl	*111661*	265 8.6 Ah
274 12.0 Pt	247 7.4 Jo	085120	U HYA	231 10.8 En	266 8.5 Ah
Nov PIC	250 7.5 Jo	274 8.9 Pt	*103212*	235 11.2 En	267 8.4 Ah
063462	271 7.1 Tf	V UMA	082 5.9 Kd	238 11.2 Bl	268 8.3 Ah
249 8.4 Ht	274 7.1 Ft	090151	110 5.7 Km	X CEN	269 8.3 Ah
S LYN	274 7.8 Fd	280 10.0 L	112 5.4 Kd	*114441*	270 8.5 Wd
063558	279 7.6 Me	W CNC	118 5.3 Kd	238 8.3 Bl	271 8.6 Jo
271 10.0 Gc	280 7.8 Tf	090425	122 5.4 Kd	AD CEN	272 8.5 Jo
274 10.0 Pt	280 8.0 Fd	280 11.1 L	122 5.7 Km	*114858*	273 8.4 Ah
280 10.0 L	281 7.9 Tf	RX UMA	145 5.6 Kd	232 9.1 Ht	274 8.3 Wr
284 10.1 Gc	T CMI	090567	RZ CAR	235 9.3 En	274 8.7 Pt
X GEM	072811	269 10.3 L	*103270*	237 9.5 Ht	274 8.4 Fd
064030	274 11.2 Pt	280 11.1 L	231 10.0 En	W CEN	276 8.3 Mc
270 11.7 Bw	277 11.8 L	RW CAR	235 10.0 En	*115058*	276 8.6 Jo
274 11.3 Bn	U CMI	*091868*	R UMA	232 9.1 Ht	276 8.6 Gy
282 11.3 Bw	073508	238 12.0 Bl	103769	235 9.4 En	276 8.4 Wd
294 10.3 Bn	266 9.9 L	R CAR	247 7.5 Jo	237 9.0 Ht	280 8.6 Fd
Y MON	274 10.2 Pt	*092062*	251 7.5 Jo	238 9.0 Bl	290 8.8 Mc
065111	274 10.0 Fd	238 5.4 Bl	256 7.2 Sz	SS VIR	290 8.4 Wd
274 12.8 Pt	277 9.5 L	X HYA	260 7.4 Ah	122001	291 8.7 Gy
277 12.7 L	S GEM	*093014*	261 7.5 Jo	266 7.0 L	298 9.1 Mc
X MON	073723	274 10.9 Pt	263 7.6 Ah	T CVN	U OCT
065208	247 11.0 Jo	280 11.4 Fd	266 7.5 Ah	122532	*131283*
266 7.6 L	250 10.5 Jo	Y DRA	266 7.4 Wd	274 10.0 Pt	231 11.7 En
271 8.1 Tf	T GEM	093178	267 7.6 Ah	U CEN	232 11.9 Ht
277 7.6 L	074323	276 9.7 L	268 7.6 Ah	*122854*	237 12.1 Ht
280 8.2 Tf	247 11.3 Jo	R LMI	268 7.5 Wd	232[12.3 Ht	238 12.4 Bl
281 8.2 Tf	250 10.9 Jo	093934	269 7.6 Ah	235[12.3 En	244 12.6 Ht
R LYN	R CNC	274 10.9 Pt	270 7.6 Jo	238 11.5 Bl	V CVN
065355	081112	274 10.7 Fd	272 7.5 Jo		131546
274 8.5 Pt	274 11.0 Pt	280 11.0 Fd	272 7.5 Sz		271 7.5 GD

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1930.

J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.
V CVn		T Aps		V Boo		S CrB		Z Lib		R CrB	
131546		*134677*		142539a		151731		*154020*		154428	
273	7.5 GD	231	10.0 En	270	7.7 Jo	266	8.8 Sz	239	12.2 Bl	270	6.1 Wd
274	7.5 GD	232	10.0 Ht	271	8.0 GD	267	8.8 Ah	R CrB		270	6.0 Jo
281	7.5 GD	237	10.6 Ht	272	7.8 Jo	268	8.8 Ah	154428		270	6.2 Pt
290	7.5 GD	238	10.3 Bl	273	8.2 Ah	269	8.7 Ah	083	6.2 Kd	271	5.8 Tf
R Hya		239	10.8 En	274	8.6 GD	271	8.3 Jo	085	6.2 Kd	271	6.1 Be
132422		242	10.9 En	276	7.9 Jo	274	8.4 Wr	104	6.2 Kd	271	6.0 Jo
232	8.0 En	244	10.8 Ht	276	8.2 Fd	276	8.6 Fd	111	6.1 Km	271	6.2 Pt
238	8.0 Bl	RU Hya		276	8.7 Mc	RS Lib		112	6.2 Kd	272	6.1 Jo
S Vir		*140528*		280	8.0 Me	*151822*		117	6.3 Kd	273	6.0 Mg
132706		231	8.2 En	290	8.8 Mc	231	9.5 Ht	117	5.9 Km	274	6.1 Pt
187	7.1 HS	232	8.0 Ht	R Cam		232	9.7 En	118	6.2 Kd	275	6.1 Pt
RV Cen		235	8.2 En	142584		236	9.5 Ht	122	6.1 Kd	275	6.0 L
133155		237	8.0 En	263	9.3 Ah	238	8.2 Bl	126	6.1 Kd	276	6.2 Pt
231	8.2 En	237	7.9 Ht	267	9.8 Ah	239	9.1 En	126	5.9 Km	276	6.0 Jo
232	7.9 Ht	238	7.7 Bl	269	9.8 Ah	242	8.3 Ht	145	6.0 Kd	276	6.0 L
237	7.8 Ht	242	8.3 En	R Boo		249	8.0 Ht	147	6.2 Kd	276	6.1 Fd
238	7.8 Bl	242	7.6 Ht	143227		R Nor		159	6.2 Kd	276	6.1 Wd
239	7.8 En	248	7.5 En	214	7.4 Wr	*152840*		171	5.9 Kd	277	6.1 Be
244	8.6 Ht	R Cen		242	9.4 Wr	231	8.9 Ht	172	6.1 Km	277	6.1 L
T UMi		*140959*		244	9.4 Wr	232	9.0 En	175	6.1 Kd	279	6.2 Pt
133273		231	6.1 En	247	9.7 Jo	236	9.2 Ht	184	6.1 Kd	279	6.0 Mg
275	13.8 L	232	6.1 Ht	251	10.0 Jo	238	9.4 En	186	6.1 Kd	280	6.0 Me
T Cen		237	6.1 Ht	261	11.0 Jo	238	9.0 Bl	187	6.0 HS	285	6.1 Pt
133633		238	6.2 Bl	263	10.8 Ah	242	9.6 Ht	196	5.9 HS	287	6.1 Pt
083	7.0 Kd	239	6.1 En	264	11.8 Pt	249	9.7 Ht	203	6.3 Kd	288	6.2 Pt
085	7.2 Kd	242	6.7 En	270	11.7 Jo	X Lib		204	6.0 Km	289	6.0 Me
088	7.3 Kd	244	6.2 Ht	S Lup		*153020*		205	6.2 Kd	290	6.1 Pt
112	7.0 Kd	248	6.6 En	*144646a*		239	12.8 Bl	211	6.2 Kd	290	6.2 Wd
118	6.3 Kd	249	6.3 Ht	239	12.1 En	W Lib		213	6.0 Kd	292	6.1 Mc
122	6.2 Kd	U UMi		Y Lup		*153215*		219	5.9 Km	294	6.0 Me
127	6.2 Kd	141567		*145254*		239	12.5 Bl	232	6.1 Kd	298	6.1 Mc
131	6.0 Kd	256	10.6 Sz	231	13.7 En	S UMi		246	5.9 HS	X CrB	
145	6.1 Kd	263	10.9 Ah	238	12.3 Bl	153378		247	6.0 Jo	154536	
147	6.1 Kd	264	10.5 Pt	239	12.4 En	251	8.5 Jo	250	6.0 L	258	12.6 B
231	6.0 En	267	10.9 Ah	S Aps		261	8.5 Jo	251	5.8 Tf	275	12.0 L
232	5.9 Ht	269	10.9 Ah	*145971*		263	8.6 Ah	251	6.1 Be	R Ser	
237	6.2 Ht	272	10.8 Sz	231	10.0 En	267	8.7 Ah	252	6.1 Be	154615	
238	6.0 Bl	273	11.0 Ah	232	10.1 Ht	269	8.6 Ah	256	6.1 Be	264	9.8 Pt
239	6.0 En	S Boo		237	10.0 Ht	270	8.5 Jo	256	6.0 L	V CrB	
242	6.0 En	141954		238	10.0 En	271	8.7 Sf	257	6.1 Be	154639	
242	6.2 Ht	247	9.7 Jo	238	9.8 Bl	272	8.6 Jo	259	6.0 Mg	258	7.0 B
RT Cen		251	9.0 Jo	244	10.0 Ht	273	8.8 Mg	261	6.1 Be	264	6.6 Pt
134236		261	9.0 Jo	248	10.0 En	273	8.8 Ah	261	6.0 Jo	273	8.0 Mg
231	9.6 En	264	8.8 Pt	249	10.0 Ht	274	8.5 Me	262	6.1 Pt	278	7.5 BL
232	9.7 Ht	270	8.8 Jo	S Ser		274	8.6 Pt	263	6.2 Pt	280	7.6 BL
237	9 7 Ht	272	8.6 Jo	151714		276	8.6 Jo	263	6.0 Ah	282	7.7 BL
238	9.4 Bl	276	8.4 L	264	8.7 Pt	276	8.8 Gy	263	6.0 Jo	288	8.0 BL
242	9.6 En	291	8.5 Gy	276	8.8 L	291	9.6 Gy	264	6.1 Be	289	8.1 BL
242	9.7 Ht	V Boo		S CrB		U Lib		264	6.0 Mg	R Lup	
R CVn		142539a		151731		*153620a*		264	6.1 Pt	*154736*	
134440		247	7.6 Jo	242	10.3 Wr	239	10.9 Bl	266	6.2 Pt	232	9.8 En
274	11.8 Pt	251	7.6 Jo	244	10.1 Wr	T Nor		266	6.0 Wd	238	10.0 En
RX Cen		261	7.6 Jo	247	9.0 Jo	*153654*		267	6.0 Ah	Z CrB	
134546		263	8.0 Ah	261	8.8 Jo	231	12.5 Ht	268	6.1 Ah	155229	
231	12.1 En	264	8.2 Pt	263	9.0 Ah	232	12.7 En	268	6.2 Sg	258	11.4 B
237	12.1 Ht	266	8.1 Ah	263	9.1 Wr	236	12.8 Ht	268	6.1 Be	264	11.5 Md
238	13.1 Bl	267	8.2 Ah	264	8.8 Pt	238	12.8 En	269	6.1 Ah	275	11.9 L
242	12.1 En	268	8.1 Ah	266	8.9 Ah	242	13.0 Ht	269	6.0 L		

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RZ Sco	V Oph	R Dra	RV Her	S Oct	UY Dra
155823	*162112*	163266	165631	*172486*	175458b
231 12.4 Ht	264 7.6 Pt	269 9.5 Ah	253 9.9 Be	231 8.9 En	288 11.0 BL
242 12.0 Ht	U Her	270 9.4 Pt	257 10.0 Be	232 8.9 Ht	RY Her
249 11.2 Ht	162119	270 9.9 Wd	258 10.2 B	237 8.5 Ht	175519
Z Sco	246 10.2 HS	271 9.3 B	261 9.8 Be	244 8.5 Ht	264 13.4 B
160021	247 10.3 Jo	274 9.2 Fd	262 9.6 Jo	249 8.8 Ht	270 13.8 Pt
231 9.4 Ht	251 10.1 Jo	275 9.3 Ma	265 10.3 Be	RU Oph	275 13.7 L
232 9.3 En	261 10.0 Jo	276 9.0 Gy	267 10.2 Mg	172809	V Dra
236 9.5 Ht	264 10.0 Pt	276 9.3 Wd	268 10.3 Sg	264 10.5 B	175654
238 9.7 En	266 9.9 B	276 9.2 Jo	269 9.9 L	270 9.5 Pt	267 12.6 Md
239 9.4 Bl	268 9.9 Sg	276 9.2 Fd	270 9.5 Pt	275 9.3 L	275 12.4 L
242 9.5 Ht	270 9.5 Jo	278 9.2 Fd	270 9.5 Jo	277 9.5 Fe	R Pav
249 9.4 Ht	271 9.9 Sf	278 9.0 Wd	272 9.7 Jo	278 10.3 BL	*180363*
R Her	276 9.4 Jo	280 9.9 Fd	272 10.2 Be	280 10.0 BL	231 12.5 Ht
160118	276 9.1 Fd	283 8.5 Wd	276 10.0 Jo	282 9.8 BL	233 12.5 En
276[11.0 Fd	294 7.8 Sf	284 8.6 Wd	277 10.5 Sg	RU Sco	239 13.2 En
U Ser	SS Her	288 8.5 Wd	279 10.2 Be	*173543*	T Her
160210	162807	290 8.2 Wd	284 10.9 Bw	232 9.8 En	180531
264 13.0 Pt	264 12.0 Pt	290 7.7 Fd	RT Sco	239 9.5 En	187 8.5 HS
X Sco	276 11.6 L	291 7.8 Gy	*165636*	SV Sco	196 8.6 HS
160221a	T Oph	RR Oph	232 9.0 En	*174135*	270 13.2 Pt
239[12.9 Bl	*162815*	*164319*	238 9.6 En	232 11.0 En	276 12.3 Fd
SX Her	239[12.0 Bl	232 8.6 En	239 8.8 Bl	239 10.8 En	279 13.0 L
160325	S Oph	238 9.1 En	— Dra	W Pav	290 11.7 Fd
262 9.1 Pt	*162816*	270 10.5 Pt	165752	*174162*	W Dra
263 8.9 Pt	239[11.8 Bl	S Her	275 9.3 L	231 9.4 Ht	180565
264 8.8 Pt	W Her	164715	RT Her	232 9.4 En	267[12.0 Md
269 8.6 L	163137	251 10.0 Jo	170627	236 9.5 Ht	270 14.2 Pt
271 8.5 Pt	247 9.9 Jo	258 10.4 B	251 11.7 Jo	239 9.4 En	279 14.5 L
274 8.5 Pt	258 9.3 B	262 10.5 Jo	262 11.5 Jo	242 9.2 Ht	X Dra
275 8.4 Pt	261 9.5 Jo	263 10.7 Ah	263 11.1 B	249 9.2 Ht	180666
276 8.3 L	270 8.4 Jo	266 10.6 Ah	270 10.5 Jo	RS Oph	279[13.8 L
279 8.4 Pt	270 8.6 Pt	270 10.7 Jo	271 10.3 Jo	*174406*	RY Oph
285 8.2 Pt	271 8.4 Sf	270 10.9 Pt	272 10.4 Jo	270 11.1 Pt	181103
287 8.2 Pt	272 8.3 Jo	RS Sco	275 10.0 L	U Ara	263 9.3 Ah
288 8.2 Pt	276 8.2 Jo	*164844*	276 10.3 Jo	*174551*	264 9.0 B
290 8.1 Pt	276 8.3 Fd	231 9.6 Ht	279 9.8 Mg	232[12.3 En	266 9.8 Sz
W Sco	294 8.0 Sf	232 9.1 En	RW Sco	236[13.0 Ht	266 9.3 Ah
160510	R UMi	236 9.8 Ht	*170833*	239[12.3 En	267 9.3 Ah
239[12.6 Bl	163172	238 9.4 En	232 9.4 En	242[13.0 Ht	268 9.5 Ah
RU Her	247 9.4 Jo	239 9.3 Bl	238 9.4 En	T Dra	270 9.0 Pt
160625	251 9.3 Jo	242 10.1 Ht	Z Oph	175458a	W Lyr
276[11.0 Fd	262 9.1 Jo	249 10.1 Ht	171401	265 10.3 B	181136
277 13.5 L	270 9.1 Jo	RR Sco	263 9.6 Ah	268 10.9 BL	247 11.8 Jo
R Sco	276 9.0 Jo	*165030a*	264 9.5 B	271 10.7 BL	262 11.8 Jo
161122a	291 10.5 Mc	231 8.4 Ht	266 9.7 Ah	278 10.7 BL	263 12.1 B
232[13.0 En	292 10.2 Mc	232 8.8 En	267 9.7 Ah	273 10.8 Mg	269 12.1 Al
236[12.6 Ht	R Dra	236 8.4 Ht	270 9.0 Pt	280 10.9 BL	270 11.5 Pt
239[12.8 Bl	163266	238 9.2 En	RS Her	282 11.0 BL	272 11.6 L
242[12.6 Ht	247 11.0 Jo	239 8.5 Bl	171723	288 11.0 BL	272 12.0 Jo
S Sco	251 10.5 Jo	242 9.1 Ht	247 8.1 Jo	UY Dra	276 12.0 Jo
161122b	261 9.8 Jo	249 9.4 Ht	262 7.9 Jo	175458b	284 11.4 Wd
232[13.0 Bl	263 10.0 Ah	SS Oph	269 8.2 Ah	265 11.1 B	290 11.0 Wd
236[12.6 Ht	265 9.8 Ah	*165202*	270 7.5 Pt	268 11.1 BL	RV Sgr
239[12.8 Bl	266 10.2 Wd	270 12.1 Pt	272 7.9 Jo	271 10.6 BL	*182133*
242[12.6 Ht	267 9.7 Ah	RV Her	273 8.3 Ah	273 11.1 Mg	233 12.6 En
W CrB	268 9.5 Ah	165631	276 7.7 Jo	278 10.8 BL	239 12.7 En
161138	268 10.0 Wd	247 9.7 Jo	284 8.9 Bw	280 10.9 BL	
264 9.8 Pt	269 9.5 Jo	251 9.7 Jo		282 10.8 BL	

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
SV HER	R SCT	RW LYR	R AQL	R SGR	AF CYG
182224	*184205*	184243	190108	*191019*	192745
263 12.6 B	261 5.8 Be	272[13.8 B	264 9.8 B	270 10.0 Pt	273 7.1 Ah
272 11.3 L	261 6.3 Bc	NOV AQL	266 10.1 Ah	271 10.1 L	TY CYG
T SER	261 6.1 Jo	184300	267 10.0 Ah	RY SGR	192928
182306	262 6.0 Bc	247 10.5 Jo	268 9.9 Ah	*191033*	269[12.9 Rs
270 11.5 Pt	262 5.9 Pt	251 10.5 Jo	269 9.8 Ah	232[12.0 Ht	271 13.8 L
279 12.1 Mg	263 6.0 Pt	263 10.5 Jo	273 9.7 Ah	235 13.2 En	RT AQL
SV DRA	264 5.8 Pt	269 11.8 Pt	RX SGR	237[12.0 Ht	193311
183149	266 5.9 Pt	270 10.5 Jo	*190818*	245[12.0 Ht	261 9.7 B
272 11.6 L	266 6.4 Be	274 11.8 Pt	235[12.4 En	264[10.0 Pt	270 10.3 Pt
275 11.5 Ma	266 6.3 Wd	276 10.5 Jo	245[12.4 Ht	271[12.1 Pt	271 10.4 L
275 11.9 Fe	268 6.2 GD	279 11.8 Pt	RW SGR	272 12.9 L	273 10.5 BE
RZ HER	268 6.1 Bg	285 11.6 Pt	*190819a*	274[12.5 Pt	277 10.6 B
183225	269 6.2 Fd	RX LYR	232 9.9 Ht	278[12.1 L	R CYG
272 13.9 L	269 6.0 Pt	185032	235 9.6 En	279[11.0 Pt	193449
X OPH	270 6.2 Pt	270 13.6 Pt	237 9.9 Ht	285 [9.0 Pt	247 8.0 Jo
183308	270 6.3 Wd	272 14.1 L	239 9.6 En	288 [9.0 Pt	251 8.3 Jo
247 8.0 Jo	270 6.0 Jo	S CRA	245 10.0 Ht	290[11.5 Pt	263 8.6 Jo
251 8.2 Jo	271 6.2 Tf	*185437a*	270 8.8 Pt	TY SGR	263 9.0 Ah
261 8.5 Jo	271 6.0 GD	232 11.8 Ht	271 9.2 L	*191124*	266 9.0 Wd
264 8.7 B	271 6.1 Be	233 12.0 En	278 9.6 Fe	235[12.4 En	267 9.1 Ah
269 8.6 Al	272 6.0 Jo	237 12.0 Ht	TY AQL	240[12.4 En	268 9.4 Ah
270 8.5 Jo	272 6.5 L	239 11.8 En	*190907*	S SGR	269 9.6 Ah
270 8.4 Pt	273 6.0 GD	245 12.1 Ht	270 10.0 Pt	*191319a*	269 9.3 Fd
272 8.6 L	274 6.5 Me	ST SGR	S LYR	235 12.3 En	269 8.7 Jo
272 8.6 Jo	274 6.1 Pt	*185512a*	190925	240 12.7 En	270 9.1 Pt
RY LYR	275 6.3 Pt	272 9.8 L	272 13.2 L	245 12.9 Ht	270 9.1 Wd
184134	276 6.2 Pt	277 9.2 Fe	X LYR	Z SGR	272 8.8 Jo
272 14.6 L	276 6.4 Fd	R CRA	190926	*191321*	273 9.4 Ah
R SCT	276 6.8 Mc	*185537a*	270 9.8 Pt	235[12.2 En	274 9.0 Sg
184205	276 6.7 Wd	232 12.5 Ht	RS LYR	240[12.4 En	274 9.6 Fd
126 6.1 Kd	277 6.5 Tf	233 12.5 En	190933a	SW SGR	275 8.6 Ma
127 6.4 Kd	278 6.4 Fd	237 12.5 Ht	272 14.0 L	*191331*	276 9.9 Gy
131 6.5 Kd	279 6.3 Pt	239 12.7 En	RU LYR	235 12.1 En	276 9.4 Wd
145 5.7 Kd	279 6.6 Me	245 11.7 Ht	190941	240 11.8 En	278 9.2 Wd
147 5.8 Kd	279 6.7 Mg	T CRA	251[13.8 Mg	TZ CYG	280 9.5 Fd
159 5.6 Kd	280 6.4 Tf	*185537b*	269[12.7 Mg	191350	283 9.3 Wd
161 5.4 Kd	280 6.6 Me	232 12.5 Ht	272[14.1 L	270 10.8 Pt	288 9.5 Wd
171 5.4 Kd	281 6.1 GD	233 13.0 En	U DRA	U LYR	290 9.7 Wd
175 5.5 Kd	284 6.7 Wd	237 12.7 Ht	190967	191637	290 9.6 Fd
184 5.3 Kd	285 6.3 Pt	239 13.2 En	270 10.0 Pt	263 10.3 Jo	291 9.8 Gy
186 5.2 Kd	287 6.2 Pt	245 12.1 Ht	272 10.0 L	269 11.1 Fd	RV AQL
192 5.4 Kd	288 6.2 Pt	Z LYR	280 10.0 Fd	270 10.5 Pt	193509
203 5.5 Kd	288 6.2 Bg	185634	W AQL	272 10.4 Jo	252 10.6 Mg
204 5.5 Kd	290 6.1 Me	265 11.7 B	*191007*	274 11.0 Fd	270 11.4 Pt
205 5.4 Kd	290 5.9 GD	270 11.6 Pt	270 11.6 Pt	275 10.9 Fd	271 11.3 L
211 5.5 Kd	290 6.1 Wd	272 12.3 L	T SGR	276 10.8 Fd	279 11.1 Mg
213 5.5 Kd	290 6.2 Pt	SU SGR	*191017*	276 10.7 Jo	T PAV
219 5.7 Kd	290 6.0 Fd	*185722*	270 11.6 Pt	276 10.7 Rs	*193972*
232 5.6 Kd	291 6.3 Mc	232 8.9 Ht	271 10.7 L	278 11.0 Fd	231 8.9 Ht
239 5.9 Kd	291 6.5 GD	237 8.7 Ht	R SGR	280 10.9 Fd	236 8.6 Ht
247 6.2 Jo	292 6.1 GD	245 8.5 Ht	*191019*	290 11.3 Fd	236 9.0 En
251 5.8 Tf	294 6.8 Mc	RT LYR	232 8.4 Ht	AF CYG	240 8.7 En
251 6.0 Jo	299 6.2 Pt	185737	235 8.5 En	192745	242 8.3 Ht
252 5.9 Be	300 6.0 Pt	272 11.5 L	237 8.5 Ht	260 7.6 Ah	249 8.5 Ht
256 6.1 L	301 5.6 Pt	R AQL	239 8.7 En	263 7.7 Ah	RT CYG
259 6.1 Mg	302 6.4 Mc	190108	245 8.8 Ht	267 7.4 Ah	194048
260 6.3 Bc		260 10.2 Ah	246 8.7 HS	268 7.7 Ah	247 12.0 Jo
261 6.2 GD		263 10.0 Ah	263 9.8 B	269 7.4 Ah	263 11.8 Jo

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RT CYG	χ CYG	SY AQL	R SGE	WX CYG	Y DEL
194048	194632	200212	200916	201437b	203611
267 11.2 Ah	271 8.6 B	252 12.3 Mg	274 9.4 Me	269 12.1 Rs	271 10.4 L
268 11.1 Ah	273 8.7 Ah	261 11.7 Br	276 8.5 Jo	270 12.9 Pt	288 10.7 BE
269 11.0 Ah	276 8.2 Jo	270 10.8 Pt	279 9.3 Me	272 12.0 L	S DEL
269 10.3 Al	276 8.6 Gy	271 11.3 L	280 9.4 Me	284 12.0 B	203816
270 11.0 Pt	276 8.9 Wd	271 10.6 B	290 8.8 Me	V SGE	252 9.9 Mg
271 12.0 Jo	278 9.0 Wd	284 10.5 Mg	RS CYG	201520	271 11.0 Pt
273 10.9 Ah	283 9.5 Wd	S CYG	200938	250 10.6 L	284 10.9 B
274 10.4 Fd	283 8.6 Bg	200357	247 7.0 Jo	266 11.3 L	284 11.4 Mg
280 9.9 Fd	290 9.0 Me	261 14.0 Br	250 7.1 Jo	271 11.4 L	V CYG
284 9.4 B	291 9.9 Gy	272 13.3 L	266 7.2 Wd	275 10.8 L	203847
290 9.0 Fd	S PAV	R CAP	268 7.2 Sg	U CYG	271 8.5 Pt
291 8.9 Gy	*194659*	*200514*	269 7.2 Jo	201647	272 8.3 L
TU CYG	236 7.7 En	261 10.3 B	270 7.2 Pt	247 7.8 Jo	275 9.4 Ma
194348	RR SGR	270 11.0 Pt	270 7.4 Wd	263 7.8 Jo	276 9.6 Sf
270 13.3 Pt	*194929*	275 10.8 L	272 7.2 Jo	266 7.8 Wd	291 9.5 Sf
272 12.8 L	236 13.0 En	277 10.2 B	272 7.4 L	269 7.8 Jo	Y AQR
X AQL	240 13.4 En	S AQL	276 7.2 Wd	269 8.2 Fd	*203905*
194604	RU SGR	200715a	278 7.1 Wd	270 7.9 Wd	247 11.8 Jo
251 8.0 Jo	*195142*	247 9.3 Jo	279 7.2 Me	270 7.5 Pt	262 9.9 Jo
258 8.5 B	231 12.1 Ht	252 9.4 Mg	280 7.6 GD	272 7.7 Jo	264 9.8 B
262 8.4 Tf	236 12.1 Ht	263 9.1 Jo	283 7.2 Wd	274 8.1 Fd	270 9.3 Jo
263 8.4 Jo	236 12.1 En	265 9.3 Be	288 7.2 Wd	274 7.6 Me	271 9.3 Pt
270 8.5 Jo	240 11.8 En	266 9.6 B	290 7.0 Wd	275 8.2 Fd	272 8.8 Jo
270 8.2 Pt	245 10.9 Ht	270 9.3 Jo	290 7.6 GD	276 7.8 Sf	276 8.5 Jo
271 8.6 L	RR AQL	272 9.5 Jo	291 7.4 GD	276 7.9 Wd	T DEL
271 8.6 Tf	*195202*	272 9.3 Be	R DEL	278 7.7 Wd	204016
271 8.6 Sf	271 12.9 B	276 10.0 Jo	201008	278 8.0 Fd	253[13.0 Be
276 8.7 Jo	271 12.7 L	284 10.3 Mg	262 12.5 Br	283 7.9 Wd	261[14.3 Br
280 9.0 Tf	RS AQL	290 9.6 Me	265 12.2 B	284 7.6 B	271[14.3 L
291 9.7 Sf	*195308*	292 9.8 Me	270 12.7 Pt	288 7.8 Wd	290[11.6 Fd
χ CYG	261[12.8 B	RW AQL	271 12.2 L	290 7.7 Wd	U DEL
194632	271 13.4 L	200715a	RT CAP	290 7.9 GD	204017
171 8.5 Kd	Nov Cyg	247 9.5 Jo	*201121*	290 7.9 Fd	262 7.1 Tf
175 8.4 Kd	195553	252 9.2 Mg	168 7.3 Kd	291 7.7 Sf	271 7.5 Tf
184 7.8 Kd	262[12.2 Pt	263 9.2 Jo	184 7.5 Kd	RW CYG	273 7.1 Tf
186 7.7 Kd	269[12.2 Pt	266 9.2 B	192 7.5 Kd	202539	277 7.0 Tf
187 7.7 Kd	274[12.2 Pt	270 9.3 Jo	203 7.2 Kd	279 8.2 Me	280 7.0 Tf
192 7.2 Kd	RR TEL	272 9.5 Jo	213 7.2 Kd	Z DEL	V AQR
203 7.0 Kd	*195656*	276 9.7 Jo	219 7.3 Kd	202817	204102
204 7.0 Kd	231 12.1 Ht	R TEL	232 7.2 Kd	261 11.7 B	271 8.2 Pt
211 7.0 Kd	236 12.1 Ht	*200747*	239 7.2 Kd	270 12.5 Pt	275 8.4 L
213 7.0 Kd	236 12.0 En	236 13.0 En	270 6.4 Pt	271 12.4 L	W AQR
219 7.0 Kd	240 12.0 En	RU AQL	SX CYG	277 12.8 B	*204104*
232 7.4 Kd	242 12.4 Ht	200812	201130	288 13.0 BE	261 12.0 B
238 7.5 Kd	Z CYG	261 10.7 B	262[13.1 Br	ST CYG	275 12.1 L
246 8.0 Kd	195849	271 10.5 L	269[12.9 Gh	202954	U CAP
247 7.0 Jo	270 12.3 Rs	273 10.8 BE	272[13.1 L	262 13.5 Br	*204215*
261 7.5 Jo	270 12.8 Pt	277 10.8 B	283[12.7 Bw	269 13.0 Gh	263 14.0 B
262 7.6 Bc	272 13.6 L	Z AQL	300[13.1 Bw	269 12.9 Rs	275 14.0 L
263 8.1 Ah	S TEL	*200906*	RT SGR	270 13.5 Pt	V DEL
266 8.6 Wd	*195855*	264 10.9 B	*201139*	272 13.9 L	204318
267 8.4 Ah	231 12.8 Ht	270 10.7 Pt	237 8.6 En	V VUL	252 12.4 Mg
268 8.4 Ah	236 12.8 Ht	R SGE	240 8.6 En	203226	261 12.5 Br
269 8.5 Ah	236 13.0 En	200916	WX CYG	270 8.5 Pt	273 13.1 L
269 8.1 Jo	240 12.9 En	247 8.8 Jo	201437b	Y DEL	284 13.3 Mg
270 8.3 Pt	242 12.8 Ht	263 8.7 Jo	247 12.0 Jo	203611	T AQR
270 8.6 Ah		270 8.6 Jo	266 12.0 Rs	265 10.2 B	*204405*
270 8.7 Wd		272 8.6 Jo	268 11.9 Gh	270 10.4 Pt	247 8.9 Jo

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T AQR	T CEP	W CYG	Y PEG	R PEG	ST AND
204405	210868	213244	220613	230110	233335
262 10.1 Jo	270 7.0 Wd	232 6.3 Kd	259 11.4 Mg	273 10.0 Ah	280 11.0 Fd
263 10.6 B	271 6.9 Pt	239 6.3 Kd	271 11.8 Pt	276 10.3 Gy	282 11.6 BL
270 11.0 Jo	273 7.0 Ah	266 6.4 L	277 11.3 L	277 10.0 Br	288 11.8 BL
271 11.5 Pt	274 6.9 Fd	277 6.3 L	277 12.2 Br	288 10.4 Bg	289 11.8 BL
272 11.2 Jo	275 7.1 Fd	S CEP	RS PEG	291 10.9 Gy	291 11.3 Al
276 11.8 Jo	276 6.4 Jo	213678	220714	291 10.9 Sf	R AQR
RZ CYG	276 7.6 Gy	267 9.6 Md	259 12.2 Mg	291 10.2 Me	*233815*
204846	276 7.1 Wd	269 9.6 Br	271 12.1 Pt	V CAS	231 8.6 Ht
271 11.2 Pt	280 7.0 Fd	271 8.6 Pt	277 12.9 L	230759	236 8.6 Ht
S IND	291 6.7 Me	272 9.4 B	277 12.3 Br	260 7.2 Ah	237 8.7 En
204954	291 6.8 Gy	RU CYG	T GRU	261 7.6 B	244 8.2 Ht
231 9.0 Ht	RR AQR	213753	*221938*	263 7.3 Ah	248 8.5 En
236 9.2 Ht	*210903*	267 8.4 Ah	236 8.9 En	267 7.6 Ah	249 7.9 Ht
237 9.6 En	259 10.5 Mg	269 8.5 Ah	242 9.2 En	268 7.7 Ah	262 8.6 Tf
242 9.6 Ht	263 10.8 B	271 7.9 Pt	S GRU	269 7.6 Ah	271 8.8 Tf
X DEL	270 11.0 Gc	282 8.4 Bw	*221948*	270 7.4 Ah	271 8.7 Pt
205017	271 10.5 Pt	290 8.1 Me	231 10.6 Ht	271 7.5 Pt	273 8.6 Tf
271 12.7 B	275 11.2 L	291 8.7 Bw	236 10.8 Ht	271 7.7 Sf	276 8.5 L
275 12.4 L	275 11.1 Fe	300 8.6 Bw	236 10.8 En	276 7.7 Rs	290 8.6 Me
R VUL	Y PAV	RV CYG	242 10.6 En	277 7.9 B	Z CAS
205923a	*211570*	213937	242 11.1 Ht	290 8.0 Me	233956
271 11.8 Pt	231 5.8 Ht	271 6.6 Pt	RV PEG	W PEG	261 14.5 Mg
284 10.1 B	236 5.6 Ht	RR PEG	222129	231425	277 14.4 L
290 9.9 Me	242 5.8 Ht	214024	277 13.9 L	251 10.0 Jo	TX CEP
TW CYG	249 6.4 Ht	259 9.0 Mg	S LAC	259 10.3 Mg	234875
210129	X PEG	267 8.8 Md	222439	262 10.2 Jo	200 13.1 Br
262 12.6 Br	211614	271 9.0 Pt	271 11.0 Pt	270 10.8 Gc	215 13.5 Br
265 12.5 Md	262 13.1 Br	R GRU	277 10.3 L	274 9.9 Fd	236 14.3 Br
275 13.0 L	271 13.4 Pt	*214247*	280 10.3 Tf	277 10.8 L	RR CAS
X CEP	276 13.5 L	231[12.9 Ht	291 8.7 Al	291 11.1 Al	235053
210382	T CAP	236[12.9 En	R IND	291 11.8 Gc	266[13.4 B
262 13.1 Br	*211615*	242[12.9 Ht	*222867*	S PEG	271[13.1 Md
275 13.0 L	272 13.5 B	V PEG	231 9.1 Ht	231508	277[13.0 B
RS AQR	276 13.6 L	215605	236 8.6 Ht	271 13.5 Pt	297[13.1 Md
210504	S MIC	269 14.0 Br	237 9.2 En	277 13.6 L	V CET
264 12.0 B	*212030*	277 14.0 Br	242 9.4 Ht	V PHE	*235209*
271 11.4 Pt	236 12.6 En	277 14.0 L	T TUC	*232746*	276 10.4 L
275 11.3 L	240 12.4 En	U AQR	*223462*	232 12.5 Ht	R TUC
Z CAP	Y CAP	*215717*	231 10.4 Ht	236 12.5 En	*235265*
210516	*212814*	261[13.3 B	236 10.9 Ht	237 13.2 Ht	236 13.3 En
261 11.6 B	275 13.0 B	267[14.5 L	236 10.9 En	Z AND	242 13.0 En
271 13.3 Pt	276 12.9 L	271 13.2 Pt	242 11.1 En	232848	245 12.7 Ht
277 12.6 B	W CYG	RT PEG	242 11.1 Ht	271 9.6 Rs	R CAS
R EQU	213244	215934	R LAC	271 9.8 Pt	235350
210812	088 6.0 Kd	250 12.5 L	223841	271 10.3 Bw	266 10.9 B
271 8.8 Pt	126 6.0 Kd	278[14.0 L	277 11.3 L	272 10.0 Md	267 11.0 Ah
275 9.0 L	127 6.0 Kd	RY PEG	RW PEG	291 10.4 Gc	268 11.3 Ah
T CEP	145 6.1 Kd	220133a	225914	300 10.0 Bw	Z PEG
210868	147 6.0 Kd	271 12.0 Gc	265 11.0 L	ST AND	235525
247 6.8 Jo	159 6.0 Kd	RZ PEG	271 10.0 Pt	233335	271 13.6 Pt
251 6.7 Jo	161 6.0 Kd	220133b	275 10.0 Ma	261 11.1 B	277 13.3 L
260 7.4 Ah	171 6.1 Kd	271[12.2 Gc	280 9.6 L	268 11.4 BL	W CET
262 6.6 Jo	184 6.3 Kd	278 12.6 L	R PEG	271 11.7 BL	*235715*
263 7.3 Ah	203 6.1 Kd	T PEG	230110	271 11.1 Pt	275 9.5 Fd
266 7.0 Wd	205 6.3 Kd	220412	267 9.9 Ah	274 10.8 Fd	Y CAS
267 7.5 Ah	211 6.3 Kd	269 14.2 Br	269 9.9 Ah	276 11.3 Fd	235855
268 7.5 Ah	213 6.3 Kd	277 14.5 L	271 9.6 Pt	276 11.6 BL	277[12.8 L
269 7.5 Ah	219 6.1 Kd	291[13.2 Gc	271 10.0 Sf	278 11.4 BL	

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840 RX ANDROMEDAE—						
	6250.3	13.0	L	6272.7	13.2	L
	6250.6	13.2	L	6273.6	12.6	L
	6256.3	11.0	L	6274.3	10.3	Be
	6257.3	11.5	L	6274.7	11.8	Pt
	6257.3	11.6	Be	6275.7	11.5	Pt
	6257.6	11.3	L	6276.3	11.3	L
	6261.6	13.3	Br	6276.5	10.5	Rs
	6262.6	13.6	Br	6276.6	11.3	L
	6262.7	12.8	Pt	6277.3	11.3	L
	6263.7	13.0	Pt	6277.6	11.3	L
	6266.3	13.1	L	6277.6	11.3	Br
	6267.3	13.3	L	6278.3	11.3	L
	6269.7	13.6	Br	6278.7	11.5	Pt
	6269.7	13.1	Pt	6279.7	11.8	Pt
	6270.7	13.2	Pt	6280.4	12.7	L
	6271.4	12.9	L	6280.7	12.8	L
	6271.7	13.3	Pt	6280.8	11.9	Pt
	6272.3	13.1	L	6290.7	11.3	Pt
060547 SS AURIGAE—						
	6250.6	14.5	L	6274.7	[12.4	Sg
	6257.6	[13.3	L	6275.4	14.1	L
	6262.7	[11.0	Pt	6275.7	14.7	L
	6263.7	[12.4	Pt	6276.6	[12.6	Rs
	6264.7	[12.6	Pt	6277.4	14.3	L
	6268.8	11.5	Pt	6278.3	14.5	L
	6269.7	11.6	Pt	6280.3	14.5	L
	6270.7	12.4	Pt	6280.7	14.2	L
	6270.7	12.1	Bw	6282.7	[13.0	Bw
	6271.4	12.0	L	6291.7	[13.2	Bw
	6271.7	12.6	Pt	6292.7	[11.8	Fe
	6272.4	12.5	L	6299.6	11.5	Pt
	6272.7	12.9	L	6300.6	11.0	Pt
	6273.7	13.7	L	6301.6	11.6	Pt
074922 U GEMINORUM—						
	6250.6	13.7	L	6275.6	13.7	L
	6257.6	[12.4	L	6276.7	13.6	L
	6266.7	13.9	L	6277.7	13.7	L
	6268.8	[13.3	Pt	6279.7	[12.4	L
	6271.7	[13.3	L	6280.7	13.7	L
	6273.7	[13.3	L	6280.8	[12.4	Pt
	6274.9	[13.3	Pt			
081473 Z CAMELOPARDALIS—						
	6250.3	12.4	L	6272.4	11.7	L
	6250.6	12.3	L	6273.4	11.5	L
	6256.3	[12.5	L	6275.3	11.3	L
	6257.3	13.0	L	6275.6	11.6	L
	6257.6	13.1	L	6276.3	11.3	L
	6266.7	11.5	L	6277.7	11.5	L
	6267.3	11.5	L	6278.3	11.5	L
	6269.3	12.1	L	6280.4	11.6	L
	6271.4	11.9	L	6280.7	11.9	L
094512 X LEONIS—						
	6250.7	[13.8	L	6276.7	[14.0	L
	6257.7	12.3	L	6277.7	[14.0	L
	6271.7	[12.3	L	6279.7	[14.0	L
	6275.7	[13.8	L	6280.7	[14.0	L
202946 SZ CYGNI—						
	6262.7	8.9	Pt	6276.7	9.2	Pt
	6263.7	8.8	Pt	6278.7	8.8	Pt
	6264.7	9.3	Pt	6279.7	8.8	Pt
	6268.8	9.3	Pt	6280.8	8.8	Pt
	6269.7	9.1	Pt	6285.7	9.3	Pt
	6270.7	9.2	Pt	6287.7	9.6	Pt
	6271.7	9.1	Pt	6288.7	9.6	Pt
	6274.7	9.5	Pt	6290.7	9.5	Pt
213843 SS CYGNI—						
	6250.4	11.7	L	6271.4	8.9	L
	6250.7	11.8	Jo	6271.7	8.6	Pt
	6251.7	11.8	Jo	6272.4	9.0	L
	6256.3	11.6	L	6273.3	9.3	Ah
	6257.3	11.5	L	6273.4	9.1	L
	6257.3	11.4	Be	6274.4	9.6	L
	6261.6	9.7	Bc	6274.6	9.5	Bc
	6261.6	9.2	Br	6274.6	9.3	Me
	6262.6	8.5	Br	6274.7	9.5	Fd
	6262.6	8.9	Bc	6274.7	9.4	Pt
	6262.7	9.2	Pt	6274.7	9.4	Sg
	6263.4	8.7	Ah	6275.6	9.8	B
	6263.7	8.9	Pt	6275.6	9.6	Fd
	6264.4	8.9	Ah	6275.7	9.5	Bc
	6264.7	9.0	Pt	6275.7	9.8	Ma
	6264.8	8.8	Md	6275.7	9.5	Pt
	6265.4	8.6	Ah	6276.5	9.5	Sf
	6265.4	8.5	L	6276.6	9.9	Wd
	6266.4	8.6	L	6276.7	9.8	Pt
	6266.5	8.6	Ah	6277.4	10.3	L
	6266.6	8.7	Sz	6277.6	10.5	B
	6266.7	8.4	Wd	6277.6	10.5	Br
	6267.3	8.6	L	6278.4	11.1	L
	6267.4	8.4	Ah	6278.5	11.0	Sf
	6267.6	8.2	Mg	6278.6	11.2	Fd
	6268.3	8.4	Ah	6279.7	11.0	Pt
	6268.6	8.5	Wd	6280.4	12.0	L
	6268.8	8.8	Pt	6280.6	11.8	Bc
	6269.3	8.8	L	6280.7	11.3	Fd
	6269.4	8.7	Ah	6280.8	11.4	Pt
	6269.5	8.7	Al	6284.6	12.1	B
	6269.6	8.3	Fd	6285.7	11.7	Pt
	6269.7	8.5	Br	6287.7	11.8	Pt
	6269.7	8.6	Pt	6288.7	11.7	Pt
	6270.4	8.7	Ah	6290.6	12.0	Fd
	6270.6	8.5	Br	6290.7	11.7	Pt
	6270.6	8.5	Wd	6290.5	11.8	Wd
	6270.7	8.8	Pt	6291.6	11.9	Al

SUMMARY FOR NOVEMBER, 1930.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	37	178	Beloit College	BE	4	4
Allen	Al	9	10	Benini	Be	3	8
Baldwin	Bl	39	41	Bigelow	Bw	6	18

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Boutell	BL	11	67	Kanda	Kd	10	98
Bouton	B	84	94	Lacchini	L	161	280
Brocchi	Br	20	28	Marsh	Ma	16	16
Brown, A. N.	Bn	3	9	McLeod	Mc	15	32
Buckstaff	Bc	3	8	Meek	Me	26	36
Bunting	Bg	4	5	Millard	Md	9	10
Ensor	En	75	136	Monnig	Mg	30	40
Ferris	Fe	9	9	Peltier	Pt	186	310
Ford	Fd	59	106	Ross	Rs	9	10
Godfrey Club	GD	6	20	Shultz	Sz	7	10
Gooch	Gh	2	2	Skaggs	Sg	8	9
Gregory	Gy	15	26	Smith, F. W.	Sf	12	19
Guiler	Gc	11	15	Taffara	Tf	16	49
Haas	HS	6	10	Webb	Wd	20	77
Houghton	Ht	61	169	Wright	Wr	4	12
Jones	Jo	57	242				
Kanamori	Km	2	8	Totals	38	393	2238

December 8, 1930.

LEON CAMPBELL, Recording Secretary.

ZODIACAL LIGHT NOTES

By W. E. GLANVILLE.

We have reached the time of year in our latitude when, in the early morning, the eastern arc of the ecliptic begins to slope more and more southward. As it does so, the morning Zodiacal Light becomes increasingly faint.

In the evening, however, the western half of the ecliptic arch is beginning to slope more and more upward and as it does so the evening Zodiacal Light comes into increasing prominence. During the next three months it will be best placed for evening observation and will provide an excellent opportunity for observers to become acquainted with its appearance.

MORNING ZODIACAL LIGHT OBSERVATIONS. During the waning of the moon of the October-November lunation cloudy weather prevented observations. Since the beginning of the November-December lunation morning observations were made on November 24, 28, 29, December 2, 4. On November 24 from 5:00 to 5:35 A.M. the Zodiacal Light was well defined from the horizon almost to Regulus. Breadth of light extended halfway between Spica and Arcturus thence broadening to the horizon. Spica was on the clear-cut edge of the south boundary. The north boundary was diffuse. At 5:20 Leo stood out clear of the light which increased in brightness to the horizon as it faded towards the apex. The shape of the light just before dawn was somewhat beehive in appearance. On November 28 between 4:55 and 5:20 A.M. the light was fainter than on November 24. The main body of the light was slightly more to the south; Spica, instead of being on the south boundary, was about 2° inside that edge and the breadth of the light between Spica and Arcturus was less than halfway to Arcturus. On November 29 from 5:00 to 5:20 A.M. the strong light was traced as far as Delta Virginis thence tapering faintly to a point below Denebola. This observation was interesting because of the easily seen difference between the strong and the diffuse light. Between Spica and Arcturus the strong light was clear halfway to Arcturus and the diffuse light two-thirds of the apparent space to Arcturus. Also, a slightly diffuse light extended about halfway between Spica and Corvus. On December 2 at 3:00 A.M.

the light was seen very faint and bandlike to Regulus. At 5:15 the light was strong, the apex being slightly east of the line joining Arcturus and Spica. On December 4 between 5:20 and 5:40 A.M. the apex was in line with Gamma Virginis; the diffuse northern boundary was about halfway between Spica and Arcturus. At 5:40 Venus was shining brightly in the midst of the horizon area of the light which was about 30° in breadth close to the horizon.

EVENING ZODIACAL LIGHT. On December 9 at 6:30 P.M. the Zodiacal Light was seen beyond the Milky Way east to a point about 15° south of Markab. Near the horizon the light was strong as it commingled with the Milky Way. Between Delta and Gamma Capricorni, bordering the south edge, and Alpha and Beta Capricorni within the north boundary, the light was fully as strong as the Milky Way in Scutum. At 8:00 P.M. while generally fainter it was still in evidence to a point south of Markab, thus giving an eastern elongation from the sun of about 80°.

GEGENSCHEIN. On November 29 at 5:00 A.M. the Gegenschein was seen in the northwest sky between the Pleiades and the Hyades and slightly to the east. Its estimated major diameter—east and west—was 15 degrees.

A friend writes to call attention to the fact that, the farther they extend from their source, searchlights fan out and he questions the use of this illustration in the paper on Zodiacal Light Theories in the November POPULAR ASTRONOMY. It is true that the beams of search lights fan out but there is always a central cone of brighter light than the boundary zones and seen more or less edgewise the fanning out is not so conspicuous. Also, it should be admitted that at the intersection of two opposite search-light beams an enhancement of the luminosity is produced.

The Rectory, New Market, Maryland.

COMET NOTES

By G. VAN BIESBROECK.

Unless further discoveries shall be made during the last week of the year, seven comets will have been found in 1930, one of which was the expected return of periodic comet Tempel II. At the beginning of 1931 two of these objects are still under observation, but they are both faint and losing in brightness.

In the evening sky PERIODIC COMET TEMPEL II remains in reach of large instruments although its very diffuse coma makes it difficult to see. On a plate exposed December 16 with the 24-inch reflector at Williams Bay the nucleus has a diameter of nearly 20″. The coma extends mostly in a southerly direction so as to form a diffuse tail visible over 2′ in the shape of a fan spread over an angle of 120°. The total brightness at that time corresponded to that of a star of magnitude 13.5. F. Seagrave has computed the following ephemeris for January; the correction is about —2 min. in right ascension only:

EPHEMERIS OF COMET TEMPEL II.

1931 0^h U.T.	h m s	° ′
Jan. 1	22 51 33	—18 6.2
9	23 14 33	—15 50.0
17	23 26 20	—13 32.3
25	23 57 0	—11 15.3
Feb. 2	0 16 45	— 9 0.8

The second object of 1930 that can still be followed is BEYER'S COMET (1930 *b*). It is now a morning object appearing as a round coma some 5″ in diameter. The estimated magnitude was 15 on December 17 but it may be really a little brighter because it was observed at a low altitude. Now that it has passed conjunction with the sun the conditions of visibility will improve and although the object will remain faint it will possibly be followed for several months more.

Besides these two comets of last year photographic observations are being continued of the two faint objects 1927 IV (STEARNS) and 1925 II (SCHWASSMANN-WACHMANN) which are well placed for northern observers. But their magnitudes, 17th and 16th respectively, are such that only powerful instruments can reach them.

No further information has become available about the object that was announced from Kyoto on November 13. Nobody has succeeded in locating it and its existence remains questionable.

No bright periodic comets are expected in 1931. ENCKE'S comes to perihelion in the beginning of June and will probably be picked up in the first month of the year. This summer it will be best placed for observers in the southern hemisphere.

This year will see also the first return of COMET 1913 III (NEUJMIN) which has a period of 17½ years. While it is a faint object intrinsically, its unique physical appearance makes it of special interest. In 1913 it showed a starlike nucleus with only the feeblest nebulosity, so that to a good many observers it appeared more like an asteroid than a comet. It will be important to secure a good record of the appearance at this opposition. Observations may begin in the late spring but it is not until late in the summer that it will be favorably situated.

The reobservation of these comets may confidently be expected in 1931. Ephemerides will be found in the *Handbook of the British Astronomical Association,* where information is also given for searching for two very faint comets which come to perihelion in 1932 but whose recovery is rather questionable. These are COMET SCHORR (1918 III) which was missed at its return in 1925 and WOLF'S SECOND PERIODIC COMET found in 1924 and followed for one month only, which leaves a good deal of uncertainty about its period of about 7½ years.

In *Astr. Nach.*, **240**, 16, S. Vsessviatsky makes an interesting discussion of the question of the origin of periodic comets. The fact that now close to 50 comets of short period have been observed and that not one well pronounced hyperbolic orbit has been recognized militates strongly against the theory of capture by some of the larger planets; from considerations of probability in a random distribution altered by the attraction of the larger planets the proportion of elliptic orbits would not be so great, even though the chances of discovery would be smaller in the case of hyperbolic orbits. The same author has recently discussed the possible change in brightness of periodic comets at successive returns and came to the conclusion that the life of these objects is probably much shorter than has been thought so far. While estimates of brightness on such diffuse objects as most comets are remains necessarily uncertain and while therefore the conclusions as to the rapid dying out of the periodic comets may not be so readily accepted, the work by this Russian investigator has stressed the great importance of recording the physical characteristics and especially the brightness of comets in general.

Williams Bay, Wisconsin, December 23, 1930.

GENERAL NOTES

Sir J. H. Jeans, of Trinity College, Cambridge, delivered the Rede Lecture on November 4, his subject being "The Mysterious Universe." (*Science,* November 28, 1930.)

Professor Albert Einstein has accepted an invitation to undertake special research work at the California Institute of Technology and Mount Wilson Observatory. He will be accompanied by Dr. Walter Mayer, of the University of Vienna, as scientific assistant. Professor Einstein expects to sail on November 30 on the *Belgenland,* which goes to California with a stop at New York. He plans to return by way of New York in February, proceeding to Oxford to fill a lecture engagement. (*Science,* November 21, 1930.)

Francis P. Leavenworth Memorial. — As a memorial to Francis P. Leavenworth (1858-1928), Professor of Astronomy at the University of Minnesota from 1897 to 1927, the University of Minnesota Press is publishing his "Measures of Double Stars," left at the time of his death. The book includes a number of measurements made by William O. Beal, who was Assistant Professor of Astronomy at the University of Minnesota from 1913 until his death in February, 1930. The records in the book were made during a period of forty years, and consist of the measures of 1,185 stars. Both Mr. Leavenworth and Mr. Beal were members of Sigma Xi and of the American Astronomical Society.

The Radio Star Gazers' Club meets at 6:15 P.M. the first day of each month in the Studios of WTAM, Cleveland, Ohio. Station WTAM has broadcast 62 astronomy lectures during the past six years.

More than 50,000 Constellation Charts have been printed and most of them distributed during the past year. The Club has thousands of members representing 37 States and several Canadian Provinces.

This special WTAM feature is conducted by Dr. O. L. Dustheimer, Professor of Astronomy, Baldwin-Wallace College, Berea, Ohio.

The Rittenhouse Astronomical Society is an organization of one hundred amateur and professional astronomers of Philadelphia and suburbs, which meets four times a year.

At the December meeting of the society the following officers were elected for the ensuing year:

President . .	Dr. George Rosengarten
Vice-President .	Mr. Harry B. Rumrill
Secretary . . .	Prof. A. Clyde Schock
Treasurer . . .	Mr. S. W. Johnson

At the same meeting Mr. Serge Korff of Princeton Observatory addressed the society upon the topic of "The Researches of Princeton Observatory" and showed motion pictures of the moon taken at that observatory.

BOOK REVIEWS

Astronomischer Jahresbericht, for 1929, issued by the Astronomischen Rechen-Institut with the coöperation of the Astronomische Gesellschaft. (Walter de Gruyter and Co., Berlin and Leipzig. 29 marks.)

This is volume 31 in the series of this name. It was prepared under direction of Dr. P. V. Neugebauer, the arrangement being the same as that of the preceding volumes. It consists of several thousand references to astronomical papers and notes which were published for the most part during the year 1929. The items are classified under nine principal headings, and these are divided into from three to eighteen sub-headings. If one wishes to know where to turn for current literature on the parallax of stars, for example, he need only to look up this section in this volume and he will find twenty-seven articles listed on this subject. It is therefore a most useful compendium for those who need to be in touch with current research in the field of astronomy.

Comets, by Professor Charles P. Olivier. (The Williams and Wilkins Company, Baltimore, Maryland, $3.50.)

This is the most recent book by the author of the very important book "Meteors," issued by the same publishers in 1925. In this as in the former book the author has taken up for discussion a class of celestial objects of great interest to the general public and to the worker in astronomy. The origin of comets, the complete change in their appearance in comparatively short time intervals, their probable fate, all are questions which have called forth much writing and much speculating. In the sixteen chapters, two hundred forty pages, of this book the author has collected the facts of cometary astronomy as they are recognized today. His aim evidently was to present a book which would be readable by anyone of average intelligence as well as to present correct viewpoints. At any rate this is what he has done.

It is difficult to select one chapter as more interesting than another, but the one in which the writer describes the "meteor crater" in Arizona and the "meteor" which fell more recently in Siberia, and refers to these as examples of collisions with small comets or parts of comets, the reader's attention is held as by the most thrilling tale. The book will fill an important place in any library.

The Rotation of the Galaxy, by A. S. Eddington. (Oxford University Press, 114 Fifth Ave., New York City. Eighty-five cents.)

This is a pamphlet of thirty pages being The Halley Lecture, which was delivered on May 30, 1930. In it are set forth in the characteristically lucid style of the author the most recent ideas relating to the topic expressed in the title. Observation and theory are combined so as to lead to most interesting conclusions. One of the surprising aspects in the lecture is the rapid progress that has been made and marked change of thought that has taken place in the last fifteen years. "But when I turn to the efforts I then [1913-15] made to fit the theory to the observed properties of the system, it is like a glimpse of the middle ages. Is it possible that only fifteen years ago we thought the stellar universe was like that!" (page 22). The reader, who is not conversant with recent research along these lines, would perhaps do well to plan for a second reading of this pamphlet.